

1-08-5100

NORTH FORK OF THE FLATHEAD RIVER  
FISHERIES INVESTIGATIONS

Prepared by  
Montana Department of Fish and Game  
February, 1979



# TABLE OF CONTENTS

	Page
TABLE OF CONTENTS .....	i
LIST OF TABLES.....	ii
LIST OF FIGURES.....	iii
LIST OF APPENDICES.....	iv
ACKNOWLEDGEMENTS.....	v
INTRODUCTION.....	1
Description of Study Area.....	2
List of Fish Species .....	3
Physical Measurements of Streams .....	3
Relative Fish Abundance .....	4
Electrofishing .....	4
Angling Surveys .....	5
Habitat Inventory .....	8
Fish Movement .....	10
Spawning Migrations .....	18
Stream Trapping .....	18
Redd Counts .....	24
Age and Growth .....	26
1977 Special Season Creel Census .....	28
SELECTED REFERENCES .....	31
APPENDIX I .....	32
APPENDIX II .....	33
APPENDIX III .....	35
APPENDIX IV .....	39
APPENDIX V .....	54
APPENDIX VI .....	62
APPENDIX VII .....	68
APPENDIX VIII .....	73

# LIST OF TABLES

Table		Page
1.	Comparison of electrofishing results in North Fork streams during 1973 - 1978 .....	6
2.	Summary of habitat inventories completed in 1977 .....	11
3.	Summary of habitat inventories completed in 1978 .....	12
4.	Total number of cutthroat and rainbow trout and Dolly Varden tagged in Flathead Lake, the Flathead River, and North Fork tributaries in 1976, 1977, and 1978 .....	13
5.	Angler harvest of cutthroat and rainbow trout and Dolly Varden tagged in the Flathead River, Flathead Lake, and the North Fork and its tributaries in 1976, 1977, and 1978 ..	16
6.	Trap catch of emigrating juvenile Dolly Varden and cutthroat trout in the North Fork drainage during 1976, 1977, and 1978 represented by number caught and percentage of each species in the total juvenile catch for each trap site .....	22
7.	Population estimates and range of lengths (in inches) for spawning Dolly Varden in North Fork Flathead River tributaries in 1977 and 1978 .....	23
8.	Physical measurements of Dolly Varden redds at stream locations .....	27
9.	Summary of the 1977 special season creel census .....	29

# LIST OF FIGURES

Figures		Page
1	Map of Flathead River System showing known spawning tributaries of Dolly Varden and cutthroat trout in the North Fork drainage and tagging and tag recovery locations of Dolly Varden and cutthroat trout .....	14
2	Map of Flathead Lake and Flathead River showing tagging and tag recovery locations of cutthroat and rainbow trout and Dolly Varden .....	15
3	Box trap and a box trap positioned in a stream .....	19
4.	Trap sites for 1976, 1977, and 1978 .....	20
5.	Numbers of downstream mountain whitefish migrants during 1977 in Big Creek as determined by downstream trapping and shocking 500 feet above the trap with circular representation of percentages of two size groups of mountain whitefish during three peak periods of downstream movement .....	25

# LIST OF APPENDICES

Appendices	Page
I Stream Discharges from Price Current Meter Measurements ....	32
II 1978 Weekly Stream Gauge Readings .....	33
III Daily Maximum Minimum Temperatures for 1977 and 1978 .....	35
IV Individual Habitat Station Data for 1978 Surveys .....	39
V Daily Trap Catch of Emmigrating Juvenile Dolly Varden and Westslope Cutthroat in North Fork Tributaries .....	54
VI Summary of Weekly Trap Catch for Upstream and Downstream Movement of Adult Dolly Varden .....	62
VII Results of Volumetric and Weight Measurements on Gravel Samples taken from Dolly Varden Redds .....	68
VIII Egg Counts from Prespawning Dolly Varden Mortalities .....	73

## ACKNOWLEDGEMENTS

Funding was provided by Dingell-Johnson funds in 1976, 1977, and part of 1978. Since June 1978 funding has been provided by the Environmental Protection Agency through direction of the Flathead River Basin Steering Committee.



## INTRODUCTION

This report contains data collected on the fishery resource and aquatic habitat in the North Fork of the Flathead River drainage from 1976 through 1978. Further analysis and discussion of this data will appear in a report scheduled for completion in June, 1979. This data represents initial efforts to collect sufficient information on the aquatic resource in the basin to predict, monitor, and mitigate changes which would be expected in light of proposed development and for use in future planning in the North Fork River Basin. This information and future data collections are being coordinated with the Environmental Protection Agency through the direction of the Flathead River Basin Steering Committee.

Large-scale salvage logging of pine beetle infested timber is occurring in the North Fork drainage in both Canada and the United States. Development of the Cabin Creek coal deposits in Canada is also proposed. Oil and gas leasing in the North Fork portion of the Flathead Forest, road reconstruction, and increasing land development may soon become realities along portions of the North Fork of the Flathead River. These and other activities illustrate the need for coordinated regional studies of the environment to aid in wise planning for future uses of the Flathead River Basin.

Streams in the North Fork drainage provide spawning and rearing habitat for westslope cutthroat trout (Salmo clarkii), Dolly Varden (Salvelinus malma), and mountain whitefish (Prosopium williamsoni) which migrate upstream from the lower Flathead River and Flathead Lake. Actual movements of whitefish are poorly understood at this time. Studies to date involved collection and analysis of data on relative abundance of juvenile fish in tributaries, spatial and temporal distribution of spawning migrations, age and growth, and aquatic habitat classification for Dolly Varden and cutthroat trout. Much of the previous work in the basin has been useful primarily for historical perspective because of less advanced techniques and low sampling intensity. Present needs require greater resolution on the population dynamics of the fishery and require increased sampling intensity.

Relative abundance of juvenile game fish in tributary streams is being collected and will be correlated to stream habitat classification. This information will be used to determine the relative contribution of each stream, or reach of stream, to the Flathead Basin Fishery. Factors which regulate or may become limiting to each species during particular life stages will be identified. The impacts of various developments can then be more accurately quantified and compared to other alternatives.

Data on spatial and temporal distribution of spawning migrations and migrations of juvenile fish provide locations and seasons when requirements of fish species should receive special attention. Flow requirements, water temperature, and quality, and habitat stability would all be associated to varying degrees. Fish harvest, natural mortality, and the probability of having both migratory and non-migratory populations in the same area will be further investigated.

Some habitat requirements are being investigated. Redds (spawning sites) for Dolly Varden were counted and measurements of associated hydraulic and physical parameters were made during their fall spawning season. High spring flows and turbidity hampered the locating of cutthroat trout redds. Additional habitat requirement data on rearing areas for juvenile salmonids is needed. Interactions between Dolly Varden and cutthroat trout should also be investigated because of the predacious nature of Dolly Varden. The relative abundance of each species is undoubtedly influenced by the other.

A creel census was used to record fishing pressure success, and recover information on tagged fish in the catch. A complete canvas of the Flathead River fishery was run in 1975, and a partial census is planned for various parts of the drainage to maximize angler contact and locate tag returns during the summer and autumn fisheries.

#### Description of Study Area

The North Fork of the Flathead River originates approximately 45 miles into Canada and joins the Middle and South Forks to form the lower Flathead about 63 miles south of the border. There are 52 major tributaries entering the North Fork along its path. The total drainage area of the North Fork and

its tributaries in the United States and Canada is over 1,400 square miles. Roughly, there is at least 1,100 miles of streams in the North Fork region. The largest individual drainage by area in the North Fork is Big Creek and the longest single stream is Whale Creek. Additional information can be obtained in other recent studies (Hanley 1977, Knapton 1978).

#### List of Fish Species

The major fish species found in the North Fork River system are the following:

westslope cutthroat trout	<u>Salmo clarki</u>
Dolly Varden	<u>Salvelinus malma</u>
mountain whitefish	<u>Prosopium williamsoni</u>
kokanee salmon	<u>Oncorhynchus nerka</u>
Arctic grayling	<u>Thymallus arcticus</u>
squawfish	<u>Ptychocheilus oregonensis</u>
longnose sucker	<u>Catostomus catostomus</u>
largescale sucker	<u>Catostomus macrocheilus</u>

On rare occasions rainbow trout (Salmo gairdneri) and lake trout (Salvelinus namaycush) have been taken in the North Fork System. At least two species of sculpins (Cottus sp.) are also present.

Aquatic insect information has been gathered at various times on the North Fork and research is continuing in this area (Stanford 1975, Flathead 208 Project 1976, and U.S. Fish and Wildlife Service 1977).

#### Physical Measurements of Streams

Discharges and temperatures were measured during the 1977 and 1978 field seasons. These parameters were monitored in part to explain fisheries utilization of North Fork tributaries. Fishery potential and tributary size were factors in deciding which streams were chosen for physical measurement.

A Price Current Meter has been in use since 1975 to measure stream velocity. Measurements with this meter were in revolutions per second. Using a data table

this rate was converted to feet per second. A compact Pygmy Current Meter will be used in areas which are inaccessible by vehicle.

Depth was measured at two-foot intervals for each stream survey. On smaller streams depths were measured at every quarter section of its width. The sum of the products of the volumes and velocities yielded a discharge rate for that section of stream. Discharge was measured during the summer and fall on the North Fork River road at bridge sites (Appendix 1). In 1978, semipermanent depth gauges were placed at bridge sites on Trail, Teepee (near Ford Station), Whale, Moose, upper Red Meadow (on Red Meadow Creek road), lower Red Meadow, Hay, Coal, and Moran Creeks and read every week (Appendix 2). Discharge rates and stream depths can be plotted to construct an individual stream rating chart from which discharge rates and depths can be calculated.

Water temperatures were measured by two methods and graphical summaries are found in Appendix 3. During 1977, temperatures were measured with maximum-minimum thermometers which were placed at each fish trap site and read each morning when traps were checked for fish. These thermometers were also used in 1978 at trap sites on Camas, Anaconda, and Kishenehn Creeks along with four 7-day recording thermographs from the U.S. Forest Service. The thermographs were placed on Trail, Whale, Coal, and Big Creeks and temperature recording charts were replaced every week.

In addition to the information already gathered on physical parameters, further collection of data is needed to document the connections between these parameters and fish utilization of streams.

### Relative Fish Abundance

#### Electrofishing

Most electrofishing was conducted on tributaries of the North Fork using two hand-held electrodes connected to a small gas generator. Usually this generator was floated down the stream in a small boat with 25 feet of cord leading to each electrode. Some river shocking was also done in the main channel of the North Fork using boat-mounted shocking equipment at night. This

was found to be the most successful time to collect cutthroat trout on the river. Fish, temporarily stunned, were netted and placed in a live car for holding. Length measurements and scales were then collected from most fish before releasing them. By periodically electrofishing the same location, ingress and egress of different age fish could be documented. In many cases cutthroat trout and Dolly Varden were tagged to provide information on movement.

Fifty five sections representing 28 streams were sampled for species distribution, size, and composition. Length of the stream sections varied from 300 to 12,000 feet. The five species of fish collected in these 28 streams were; Dolly Varden, westslope cutthroat trout, mountain whitefish, sculpins, and a few grayling. A preliminary estimate of abundance based on numbers of cutthroat, Dolly Varden, and whitefish shocked per 1,000 feet of stream was determined (Table 1). The length range in inches for each of these species is also included. Cutthroat appeared to be the most abundant in Kletomus and Red Meadow Creeks with 62 and 32 trout per 1,000 feet, respectively. The largest Dolly Varden count was in Red Meadow Creek at 40 fish per 1,000 feet. The North Fork River Channel produced the best whitefish results with 20 fish per 1,000 feet.

### Angling Surveys

Angling surveys were done in 1976, 1977, and 1978 where electrofishing was not permitted or not feasible because of inaccessibility. Spinners, natural bait, and artificial flies were all used to catch fish.

In 1976, Camas, Anaconda, Ford, Quartz, Dutch, and Logging Creeks in Glacier Park and Colts, Hay, Teepee, Moose, and Red Meadow Creeks in the Flathead National Forest were sampled with the intent of catching spawning cutthroat trout. Only two mature cutthroat were caught. One was a spawned-out 17.0-inch male caught in Red Meadow Creek and the other was a ripe 16.0-inch smaller, male caught in the North Fork near the mouth of Ford Creek. Several smaller, probably immature cutthroat were also caught.

In 1977, portions of two streams were surveyed by angling. About one-half

Table 1: A Comparison of electrofishing results in North Fork streams during 1973 - 1978.

Main Streams and Tributaries	Total Feet of Stream Shocked	Number of Fish by Species			Fish Per 1,000 Feet of Stream		
		WCT*	DV	MWF	WCT	DV	MWF
Big Creek	13,800	10 (3.8-14.2)	22 (2.8-31.4)	297 (7.0-16.8)**	1	2	20
Lookout Cr.	1,200	18 (3.6-6.9)	0	0	15	0	0
Elelehum Cr.	1,000	0	0	0	0	0	0
Hallawatt Cr.	1,000	1 (8.6)	8 (4.8-27.1)	0	1	8	0
Skookoleel Cr.	1,500	2 (4.4-4.8)	6 (4.0-5.9)	0	1	3	0
Nicola Cr.	1,000	2 (5.0-5.4)	7 (4.4-6.7)	0	2	7	0
Kletomus Cr.	500	31 (2.5-9.4)	0	0	62	0	0
Werner Cr.	1,000	5 (5.7-7.6)	1 (7.5)	0	5	1	0
Coal Creek	4,200	23 (4.1-13.7)	55 (3.4-29.8)	17 (9.4-15.4)	6	13	4
Cyclone Cr.	1,000	17 (2.5-6.2)	0	0	17	0	0
Deadhorse Cr.	1,000	25 (3.1-7.5)	0	0	25	0	0
South Fork Coal Cr.	2,000	11 (3.9-10.4)	15 (4.3-10.0)	0	6	8	0
Mathias Cr.	1,000	4 (6.7-9.3)	12 (5.1-7.4)	0	4	12	0
Colts Creek	400	11 (1.8-8.9)	0	0	28	0	0
Hay Creek	2,950	57 (2.8-10.6)	35 (3.0-26.0)	14 (8.2-12.2)	19	12	5

\* - WCT = Westslope Cutthroat, DV = Dolly Varden, MWF = Mountain Whitefish

\*\* - (Length Range in Inches)

Table 1: Continued

Main Streams and Tributaries	Total Feet of Stream Shocked	Number of Fish by Species		Fish Per 1,000 Feet of Stream		
		WCT*	DV	WCT	DV	MWF
Howell Creek	6,600	10 (4.3-9.9)	43 (2.8-8.1)	2	6	1
Kimmerly Creek	1,000	23 (4.1-7.7)**	0	23	0	0
Kishenehn Creek	13,200	34 (2.0-11.3)	59 (2.7-7.5)	3	4	2
McGinnis Creek	2,000	5 (6.5-8.3)	14 (5.5-6.8)	2	7	4
Moose Creek	3,000	26 (3.9-7.9)	2 (5.4-7.2)	8	1	0
Moran Creek	2,000	25 (3.4-7.5)	1 (7.9)	12	1	0
Red Meadow Creek	11,800	381 (2.0-10.6)	473 (2.2-26.0)	32	40	1
Teepee Creek	2,000	8 (4.0-10.0)	0	4	0	0
Trail Creek	33,740	59 (3.1-12.0)	653 (2.4-34.0)	2	19	5
Antley Cr.	300	0	0	0	0	0
Nokio Cr.	1,300	5 (4.3-9.8)	0	4	0	0
Tuchuck Cr.	1,000	19 (3.1-7.7)	0	19	0	0
Whale Creek	27,760	9 (3.7-11.2)	257 (2.3-30.0)	1	9	1
North Fork River Channel	38,280	24 (5.5-11.6)	9 (6.5-11.0)	1	1	22

\* - WCT = Westslope Cutthroat, DV = Dolly Varden, MWF = Mountain Whitefish

\*\*- (Length Range in Inches)

mile of Kishenehn Creek in Glacier Park and about one mile of Shorty Creek in the Flathead National Forest were surveyed. Numerous six to nine-inch cutthroat were caught in Kishenehn Creek, of which eight were dissected to determine maturity. Both mature and immature fish of the same size were found. Because of the small size of the mature fish, we believe that a resident spawning population may exist in some streams. Most of the smaller fish were probably migrants that travel downstream to Flathead Lake to rear until they reach maturity, then return to the stream to spawn. Several five to eleven-inch cutthroat were caught in Shorty Creek and all appeared to be resident fish.

In 1978 about two miles of Spruce Creek in Glacier Park were sampled and approximately the same length was surveyed on Kishenehn Creek. Twenty 5 to 8-inch cutthroat were caught on Spruce Creek. Two fish of the same length were dissected with one being mature and the other immature. Seventy 6 to 9-inch cutthroat trout were caught in the area surveyed on Kishenehn Creek. All were fin-clipped for identification purposes.

Problems with angling surveys were relatively low catch rates over long periods of time and covering a large number of streams with a limited number of people.

#### Habitat Inventory

Habitat inventory on five North Fork streams was conducted during 1977 and 1978. A modified method of the Dunham and Collotzi inventory was used in the North Fork habitat evaluation. This modified method was also used by the U.S. Fish and Wildlife Service to collect information in the lower one mile of streams running from Glacier National Park into the North Fork of the Flathead.

The 400-foot sampling stations were located approximately every mile along the stream with the first station on each stream located less than a mile upstream from the North Fork channel. The Dunham method evaluated fishery habitat for a station as a percentage of optimum needs compared to the "perfect stream" for trout. The evaluation is concerned with four

primary features: pool measure, pool structure, stream bottom and stream bank environment. Each station contained five channel transects spaced 100 feet apart. The above four features were evaluated along each transect with each feature contributing one-fourth of the cross-section appraisal.

Pool measure was the percentage of stream width determined to be a pool. An optimum situation was considered to be a pool-to-riffle ratio of 50/50. Pool structure was determined by length, width, depth, cover, and turbidity. Pools were then rated according to the degree to which each parameter was exhibited. Stream bottom, the third feature, was determined by the footage of boulder, rubble, gravel, sand-silt, and other material located along the cross-channel line. Percentage of total bottom width containing rubble and gravel represented one-fourth of the cross-channel rating. Whether the stream banks on either end of the line had forest or brush cover and/or was exposed determined the rating for Stream Bank Environment. Based upon these four features, calculations were made for each section and all five sections combined determined the percentage of optimum habitat. This percentage was then compared to the "perfect stream" with a rating of 100 percent.

In conjunction with this inventory, velocities and flows were determined at each station by using a Price Current Meter. Additional observations on insects, vegetation, and the surrounding land were also recorded. Theoretically since the location of each station was permanently marked, any changes in the habitat resulting from natural disasters or man's activities could be documented by returning to these stations and repeating the inventory.

There has been some question as to the value of this method in acquiring a useful picture of the total stream. Pool structure has a consistently low rating for nearly all stations. This is probably due to high runoff conditions which scour the streams and redistribute much of the smaller substrate into existing pools resulting in many shallow pools. These shallow pools generally receive a low rating with the Dunham method; however, they may rate highly as a spawning and nursery habitat.

As a result of this uncertainty, during the 1979 field season we plan to

work more intensively using common stream reaches and attempt to evaluate habitat suitability in each reach. Reach boundaries would be determined where the character of the stream significantly changed due to gradient, aspect, substrate, canopy, or man's activities. The reach would be evaluated as fishery habitat and within each reach a 400-foot station would be established and intensive fish and habitat data collected. Other intensive habitat inventories will be investigated.

Results of all stations done on Trail, Moose, and Hay Creeks for 1978 are presented in Appendix 4. These are displayed similar to the computer printout for each station. The summaries for all stations sampled in 1977 and 1978 are located in Tables 2 and 3. The percent of optimum for the entire stream ranged from 37.0 percent for Coal Creek to 48.5 percent for Red Meadow Creek. Individual stations ranged from 26 percent of optimum for Hay Station One and Coal Station Nine to 68 percent for Red Meadow Station Six.

#### Fish Movement

Extensive fish tagging, cold branding, and fin clipping has been done on Flathead Lake, the Flathead River, and some of the tributaries of the North Fork in 1976, 1977, and 1978 to determine fish movement throughout the Flathead River Basin. Red, yellow, and international orange numbered anchor tags were used on cutthroat trout and rainbow trout over 12 inches and on Dolly Varden over 17 inches. Tags were inserted at a 45-degree angle at the posterior end of the dorsal fin. Over the past three years, a total of 779 cutthroat trout, 48 rainbow trout, and 153 Dolly Varden have been tagged (Table 4). Fish were collected for tagging by electrofishing, trapping, and gill netting. Tagging and tag recapture locations are shown in Figures 1 and 2. The highest number of fish tagged was in the lower Flathead River near Kalispell in the Salmon Hole, Old Steel Bridge, and Highway #2 Bridge areas. The majority of tagged fish recaptured by angling and/or electrofishing has also been in these three areas. Percent harvest was based on the total number of fish tagged and the total number of tagged fish recaptured by angling over the three-year period (Table 5). Of the total recaptures of tagged fish, 15 were caught in the North Fork area in British Columbia and the remainder were caught in Montana. The greatest

Table 2: Summary of habitat inventories completed in 1977.

Red Meadow Creek								
Feature	1	2	3	4	5	6	7	Composite
Pool Rating	16	22	26	33	32	47	34	30.0%
Pool Structure	0	12	0	33	26	47	19	19.6%
Stream Bottom	71	92	64	82	95	98	75	82.4%
Environment	35	40	86	45	80	79	68	61.8%
% of Optimum (each Station)	31	41	44	49	58	68	49	

% of Optimum (entire stream) = 48.5%

Coal Creek										
Feature	1	2	3	4	5	6	7	8	9	Composite
Pool Rating	26	36	11	21	20	17	5	22	16	19.0%
Pool Structure	5	14	0	5	20	0	0	17	9	9.0%
Stream Bottom	46	80	90	79	72	42	77	81	89	68.0%
Environment	33	59	53	34	44	60	59	73	31	51.0%
% of Optimum (each Station)	27	47	38	35	39	30	35	48	26	

% of Optimum (entire stream) = 36.1%

Table 3: Summary of habitat inventories completed in 1978.

Trail Creek						
Feature	1	2	3	4	5	6
Pool Rating	27	31	6	14	43	18
Pool Structure	0	5	0	0	0	0
Stream Bottom	71	59	70	49	57	79
Environment	66	85	90	60	39	39
% of Optimum (each Station)	41	45	42	31	35	34
% of Optimum (entire stream) = 38.0%						

Moose Creek					
Feature	1	2	3	4	5
Pool Rating	15	9	35	67	38
Pool Structure	15	0	35	44	0
Stream Bottom	70	39	61	32	55
Environment	34	69	40	68	30
% of Optimum (each Station)	33	29	43	53	31
% of Optimum (entire stream) = 37.8%					

Hay Creek				
Feature	1	2	4	5
Pool rating	12	42	49	9
Pool Structure	0	40	35	0
Stream Bottom	40	46	55	47
Environment	53	70	59	55
% of Optimum (each Station)	26	49	49	28
% of Optimum (entire stream) = 38.0%				

Table 4: Total number of cutthroat and rainbow trout and Dolly Varden tagged in Flathead Lake, the Flathead River, and North Fork tributaries in 1976, 77, and 78

<u>Year tagged</u>	<u>Species</u>	<u>Number of fish tagged</u>
1976	Adult westslope cutthroat	168
	Juvenile westslope cutthroat	27
	Rainbow trout	4
	Adult Dolly Varden	2
	Juvenile Dolly Varden	2
1977	Adult westslope cutthroat	331
	Juvenile westslope cutthroat	30
	Rainbow trout	15
	Adult Dolly Varden	109
	Juvenile Dolly Varden	4
1978	Adult westslope cutthroat	193
	Juvenile westslope cutthroat	30
	Rainbow trout	29
	Adult Dolly Varden	26
	Juvenile Dolly Varden	10

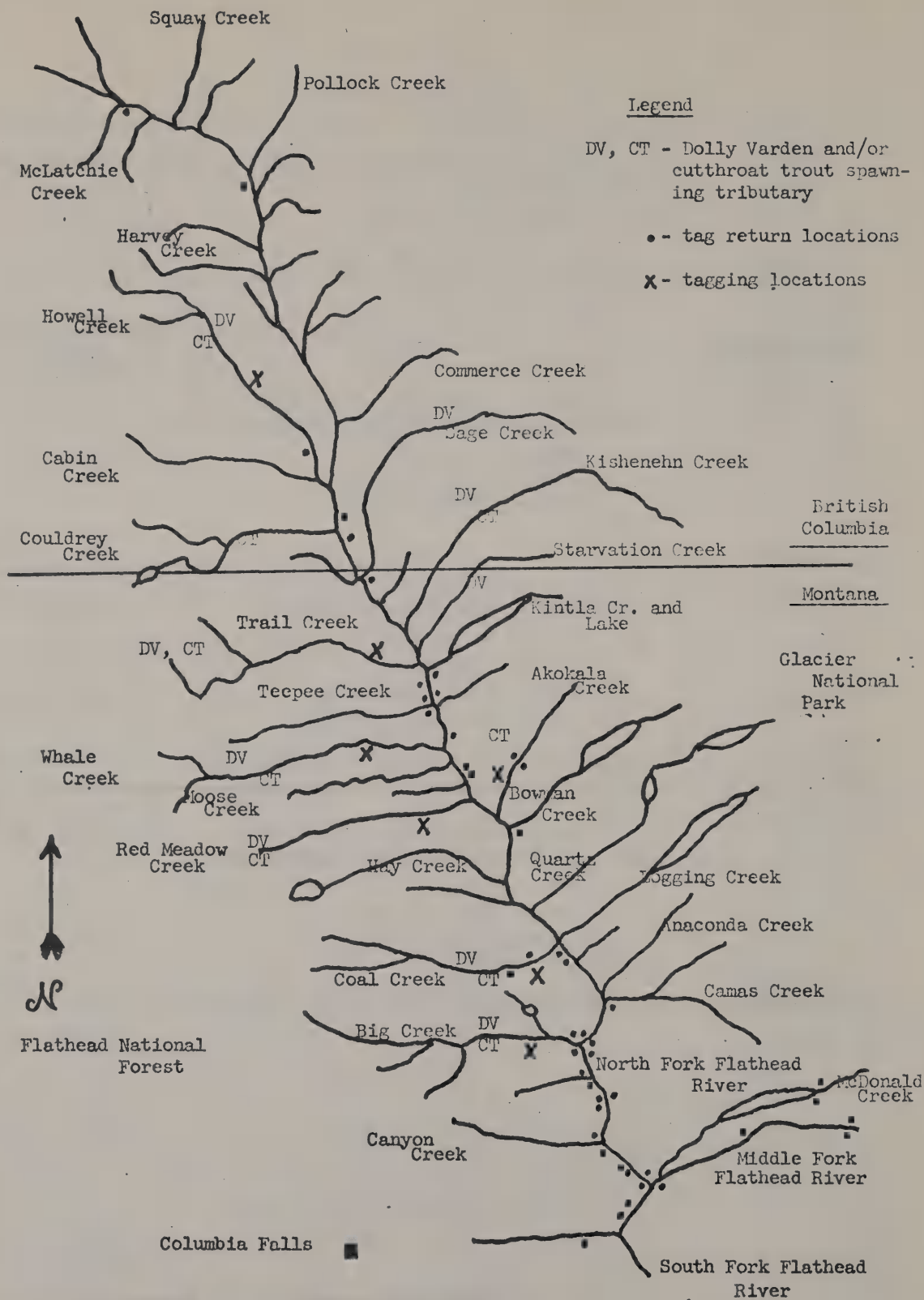


Figure 1. Map of Flathead River System showing known spawning tributaries of Dolly Varden and cutthroat trout in the North Fork drainage and tagging and tag recovery locations of Dolly Varden and cutthroat trout

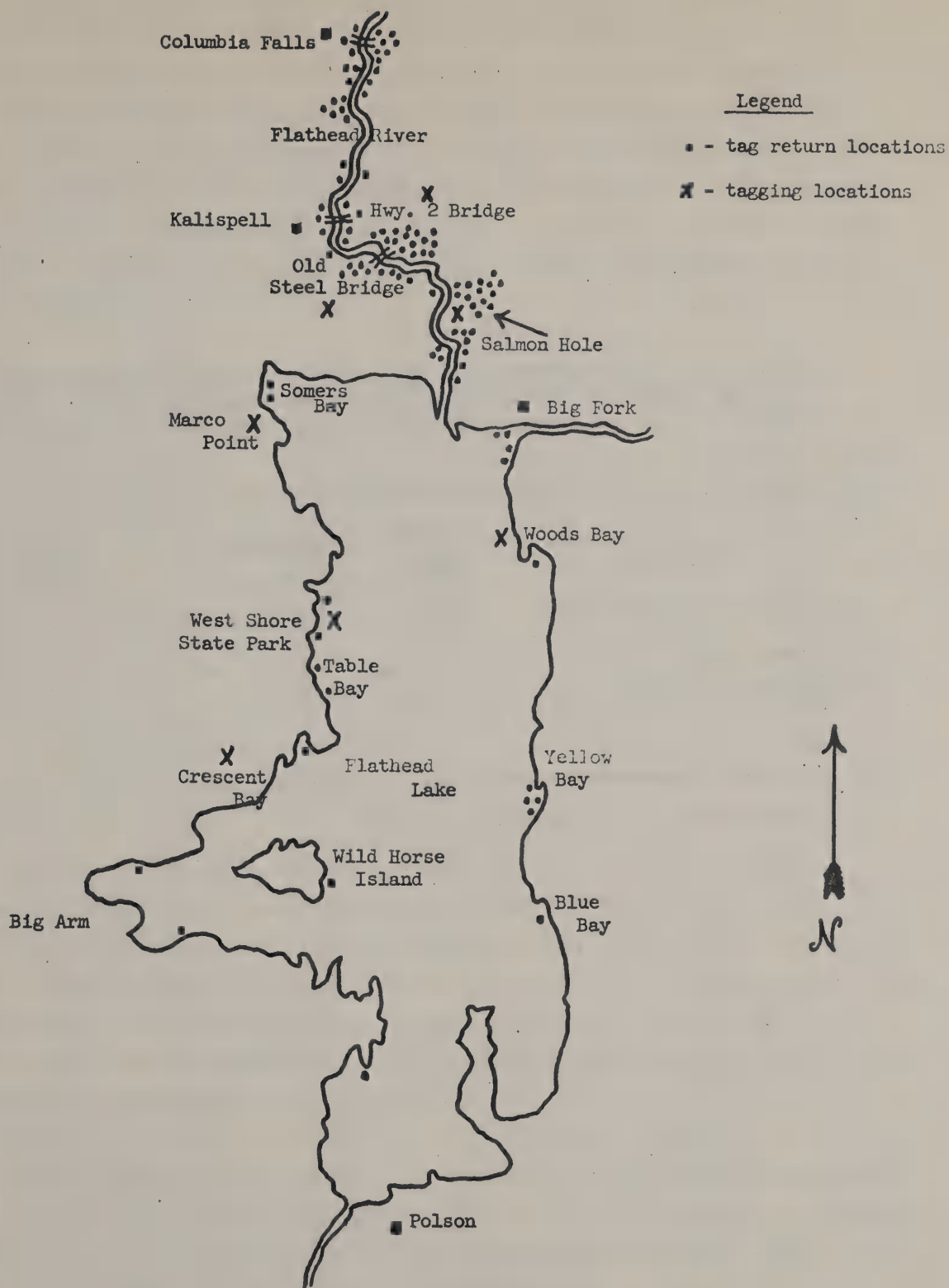


Figure 2. Map of Flathead Lake and Flathead River showing tagging and tag recovery locations of cutthroat and rainbow trout and Dolly Varden

Table 5: Angler harvest of cutthroat and rainbow trout and Dolly Varden tagged in the Flathead River, Flathead Lake, and the North Fork and its tributaries in 1976, 77, and 78.

<u>Species</u>	<u>Number recaptured</u>			<u>Total (76-78)</u>	<u>Percent*</u> <u>harvest</u>
	<u>1976</u>	<u>1977</u>	<u>1978</u>		
Adult westslope cutthroat	25	58	19	102	15.0%
Juvenile westslope cutthroat	3	3	4	10	11.0
Rainbow trout	0	3	5	8	17.0
Adult Dolly Varden	1	1	7	9	7.0
Juvenile Dolly Varden	0	1	1	2	8.0

\*These figures are minimum estimates

number of recaptures of Dolly Varden, cutthroat, and rainbow trout from Flathead Lake occurred between May and August. From the mouth of the Flathead River to Columbia Falls, the majority of recaptures occurred from March to September, and in the North Fork from the mouth upstream into British Columbia most recaptures occurred between May and July. The Farthest distance traveled was by a 15.8-inch cutthroat trout that was tagged in the Salmon Hole area near Kalispell. It was recaptured in the North Fork near McLatchie Creek in British Columbia, a distance traveled of about 140 miles.

Cold branding and fin clipping are two methods that have been used for marking large numbers of juvenile Dolly Varden and cutthroat trout between 2 and 12 inches. Branding of fish with liquid nitrogen was done in 1977 in the North Fork tributaries where fish trapping and/or shocking was done. The brands were placed on the side between the lateral line and dorsal fin. They will increase in size as the fish grows. Individual brands for North Fork tributaries were as follows:

Big Creek	<b>E</b>	Whale Creek	<b>K</b>
Coal Creek	<b>E</b>	Trail Creek	<b>K</b>
Akokala Creek	<b>P</b>	Howell Creek (B.C.)	<b>la</b>
Red Meadow Creek	<b>b</b>		

Individual fins were clipped on fish that were either trapped or shocked for marking and identification purposes in specific streams in the North Fork. Fin clips for different streams were; Big Creek - no clip, Coal Creek - right pectoral, Akokala Creek - left pelvic, Red Meadow Creek - adipose, Whale Creek - left pectoral, Trail Creek - anal, and Howell Creek - right pelvic. Fin clipping was only a short term marking procedure as the clipped fins usually regenerate within a year.

Little information has been collected from the mass-marking program to date because most of the fish have not grown to a catchable size. Tagging locations and recapture efforts will be expanded to other areas and seasons in future years to minimize bias in results.

## Spawning Migrations

### Stream Trapping

Fish trapping was done on the North Fork of the Flathead River and its tributaries in 1976, 1977, and 1978. Traps were used to determine which creeks had a spawning run of migratory Dolly Varden and westslope cutthroat trout. Duration of the high water period, available personnel and data desired dictated the intensity of the trapping effort each year. Box traps of EMT pipe frames covered with half inch mesh hardware cloth and a plywood top were used. One inch poultry netting leads were wired to each side of the trap and stretched diagonally to the shoreline (Figure 3). The boxes and leads were installed to capture either adults migrating upstream or juveniles emigrating downstream. Spacing of the two gates of the trap entrance was about three inches. Presence of runs of spring spawners, such as cutthroat, were determined from the number of emigrating juveniles. In contrast, the Dolly Varden is a fall spawner and the adults moving upstream can be trapped.

Two goals for the 1976 field season were to determine useful trapping methods and identify spawning runs. Trapping for smolts began in mid-July and continued through mid-August. Logging, Moran, Coal, Cyclone, Big, Akokala, and Red Meadow creeks were trapped. A trap was placed at either end of the North Fork River side channel that Hay and Moran Creeks enter. The high water channel fed by Spring Creek was also trapped (Figure 4). One upstream trap was used in Coal Creek.

Water levels were suitable for trapping in 1977 by mid-June, an entire month earlier than in 1976. Big, Coal, Red Meadow, Whale, and Trail Creeks all had upstream and downstream traps. Akokala and three traps in the North Fork near Polebridge were all downstream traps. All traps were removed by mid-October (Figure 4).

All trapping efforts in 1978 were within Glacier National Park. Above average snowpack coupled with heavy June rains maintained high water levels until mid-July when traps were installed. Trapping continued until early

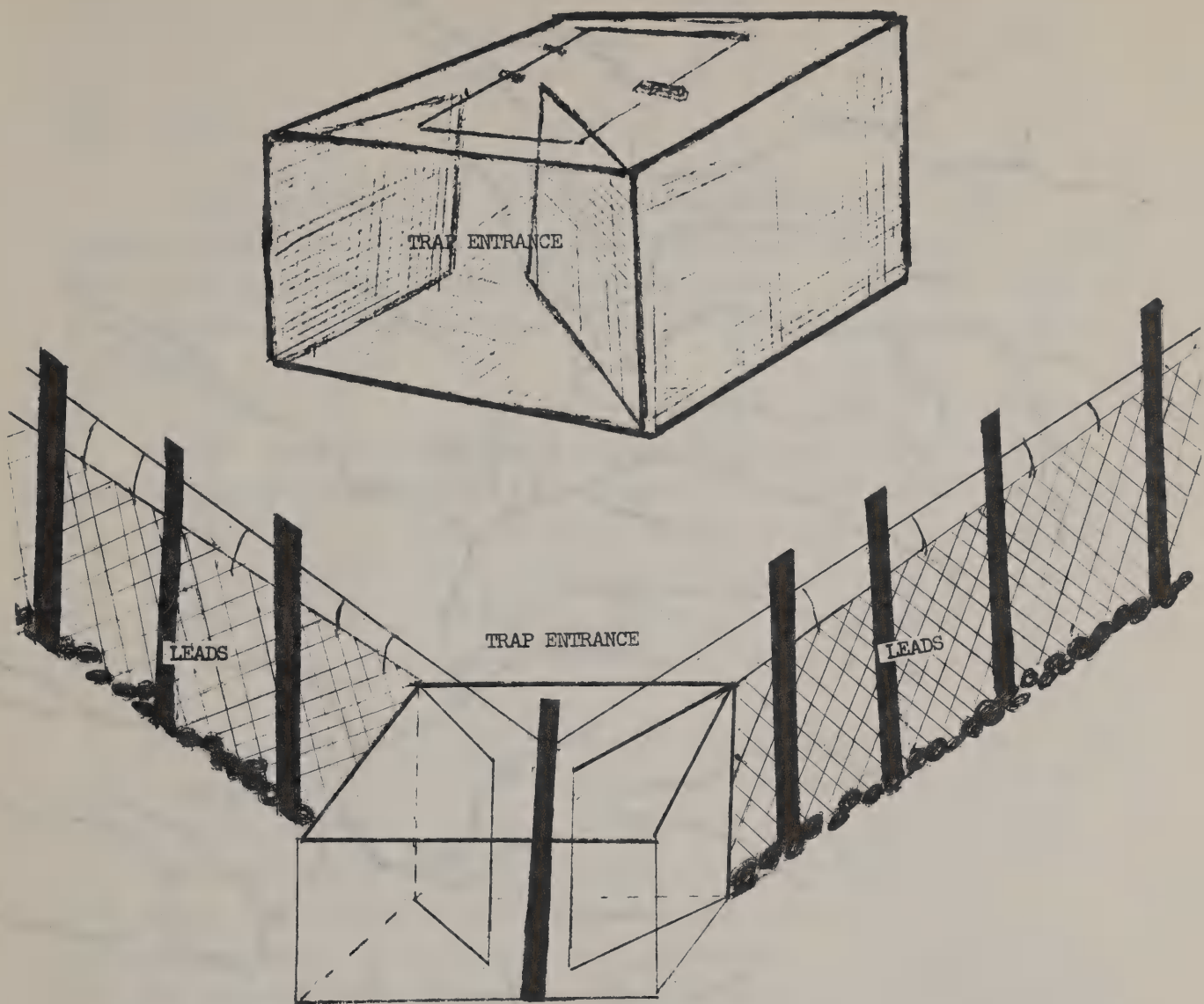


Figure 3: Box trap and the trap positioned in a stream

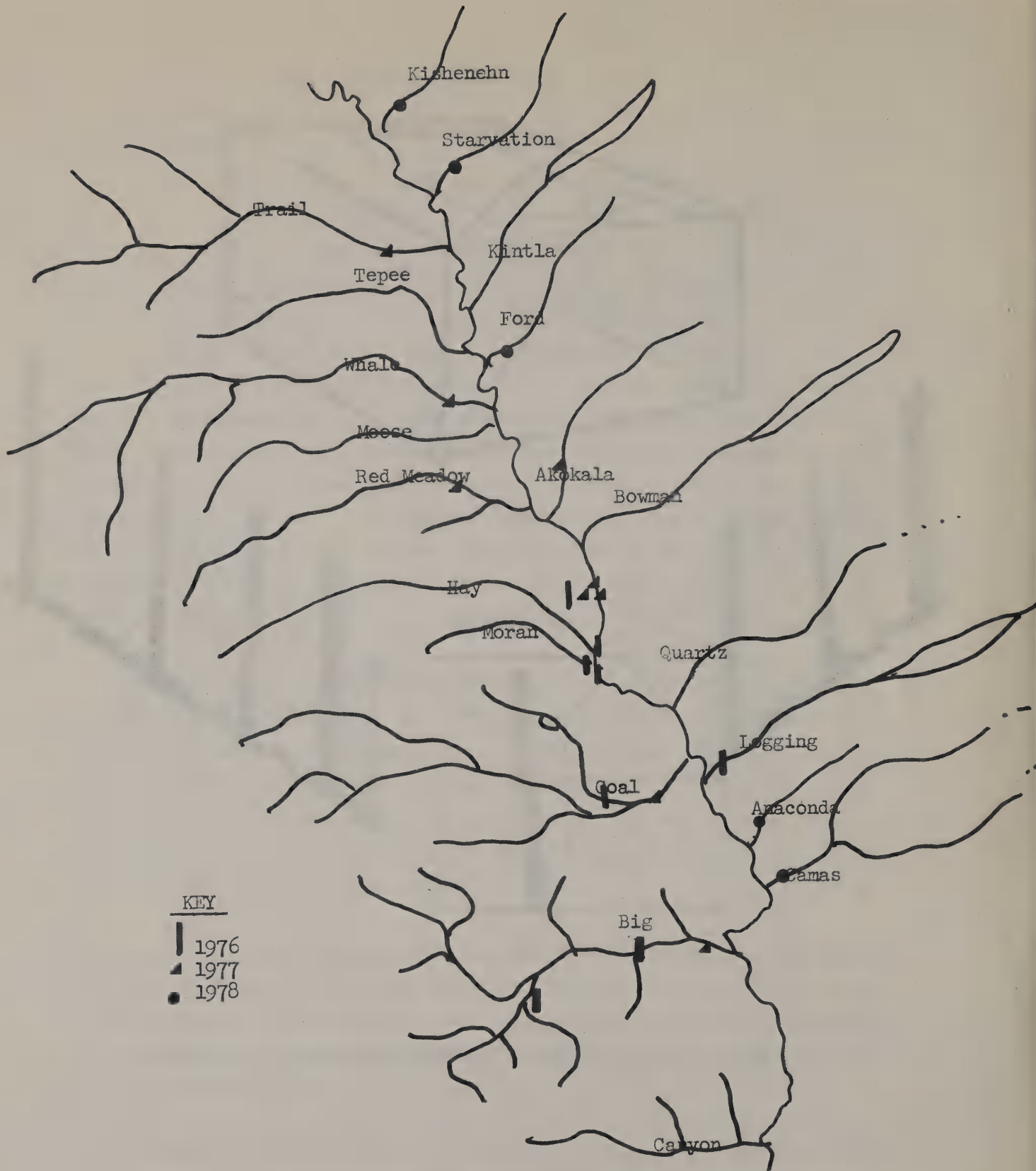


Figure 4: Trap sites for 1976, 1977 and 1978

September. Downstream traps were installed on Ford and Anaconda Creeks and one upstream trap and a partial downstream trap were used in Kishenehn Creek. Both upstream and downstream traps were put in Starvation and Camas Creeks.

Problems associated with trapping include trap maintenance, rapid changes in water levels, site selection and gilling of small fish. Water borne debris caused the greatest maintenance problem. Larger mesh serves to alleviate debris problems but reduces trap efficiency and increases gilling problems.

The 1976 trapping effort indicated that Red Meadow, Akokala, and Coal Creeks had emigrating cutthroat trout (Appendix V). Cyclone and Moran Creek traps did not catch any cutthroat trout. Visual observations and hook and line sampling on Logging Creek indicated that 4 to 10-inch cutthroat were numerous, but the trap installed later caught only six cutthroat trout. The status of migrating cutthroat trout in Logging Creek remains a question.

All six streams trapped in 1977 caught emigrating trout. Trap catches from Akokala and Coal Creeks were predominantly cutthroat. More than 50 percent of the emigrants trapped in Red Meadow, Whale, and Big Creeks were cutthroat trout. In contrast, Trail Creek had the fewest cutthroat but the most juvenile Dolly Varden of any stream trapped in 1977 (Table 6). Although cutthroat were found in all creeks trapped in 1978, the catch from Ford and Anaconda Creeks was small. Camas, Starvation, and Kishenehn Creeks seemed to have significant cutthroat populations but should be studied further.

Spawning Dolly Varden were caught in Big, Coal, Red Meadow, Whale, and Trail Creeks in 1977 (Appendix VI). In 1978, spawning Dolly Varden were caught in Kishenehn and Starvation Creeks (Table 7). In drainages trapped in 1977, the timing of downstream movement of spent Dolly Varden seemed to be similar in Big and Coal Creeks whereas in Red Meadow, Whale, and Trail Creeks, downstream movement occurred later.

While maintaining the traps in 1977, some data was incidentally recorded

**Table 6:** Trap catch of emigrating juvenile Dolly Varden and cutthroat trout in the North Fork drainage during 1976, 77, and 78 represented by number caught and percentage of each species in the total juvenile catch for each trap site.

<u>Creek</u>	<u>Total number</u>	<u>Percent</u>	<u>Total number</u>	<u>Percent</u>
<u>1976</u>	<u>Dolly Varden</u>	<u>Dolly Varden</u>	<u>cutthroat</u>	<u>cutthroat</u>
Big	0	0	0	0
Coal	19	42	26	58
Cyclone	0	0	0	0
Logging	1	14	6	86
Moran	0	0	0	0
Akokala	0	0	36	100
Red Meadow	7	5	102	95
<u>1977</u>				
Big	79	39	129	62
Coal	53	9	535	91
Red Meadow	21	18	98	82
Whale	100	48	109	52
Trail	157	65	83	35
Akokala	2	1	361	99
River traps	145	61	227	39
<u>1978</u>				
Camas	1	4	25	96
Anaconda	3	43	4	57
Ford	0	0	3	100
Starvation	41	52	38	48
Kishenehn*	-	-	34	-

\*Kishenehn Creek did not have a downstream trap; these fish were gilled in the leads of the upstream trap.

Table 7: Population estimates and range of lengths (in inches) for spawning Dolly Varden in North Fork Flathead River tributaries in 1977 and 1978.

<u>Creek</u>	<u>Estimated number</u>		<u>Size of females</u>			<u>Size of males</u>		
	<u>of spawners</u>							
<u>1977</u>	<u>Females</u>	<u>Males</u>	<u>Min.</u>	<u>Avg.</u>	<u>Max.</u>	<u>Min.</u>	<u>Avg.</u>	<u>Max.</u>
Big	60	60	20.0	25.0	29.7	17.5	22.5	27.0
Coal	110	139	18.5	23.4	28.2	15.9	21.3	31.0
Red Meadow	34	50	17.1	20.6	27.9	16.1	19.2	27.2
Whale	137	124	19.0	26.7	34.5	16.0	24.3	31.2
Trail	36	60	21.9	28.2	32.5	22.0	25.9	32.0
<u>1978</u>								
*Starvation	11	5	24.8	27.6	30.0	18.0	22.3	27.0
*Kishenehn	6	3	24.6	25.3	27.8	22.2	24.7	27.4

\*Actual trap catch, total number of spawners likely large

on mountain whitefish. Because whitefish were reluctant to enter the trap, electrofishing above the trap was the best way to move these fish downstream. It was noted that whitefish, ten or more inches, were moving downstream in late July and throughout August. Most of these larger, mature fish seemed to move during a two-week period which seemed concurrent with a sharp decrease in the movement of the four to nine-inch whitefish. The most complete length data was collected on Big Creek (Figure 5).

The movement of mountain whitefish, including mature fish, from the tributaries into the North Fork may have been a feeding and spawning migration. Similar whitefish feeding and spawning movements has been documented on the Sheep River drainage in Canada (Davies and Thompson 1976). However, spawning whitefish in the Kootenai drainage move from the main river into tributaries to spawn (Huston and May 1975). Further study is needed in this area.

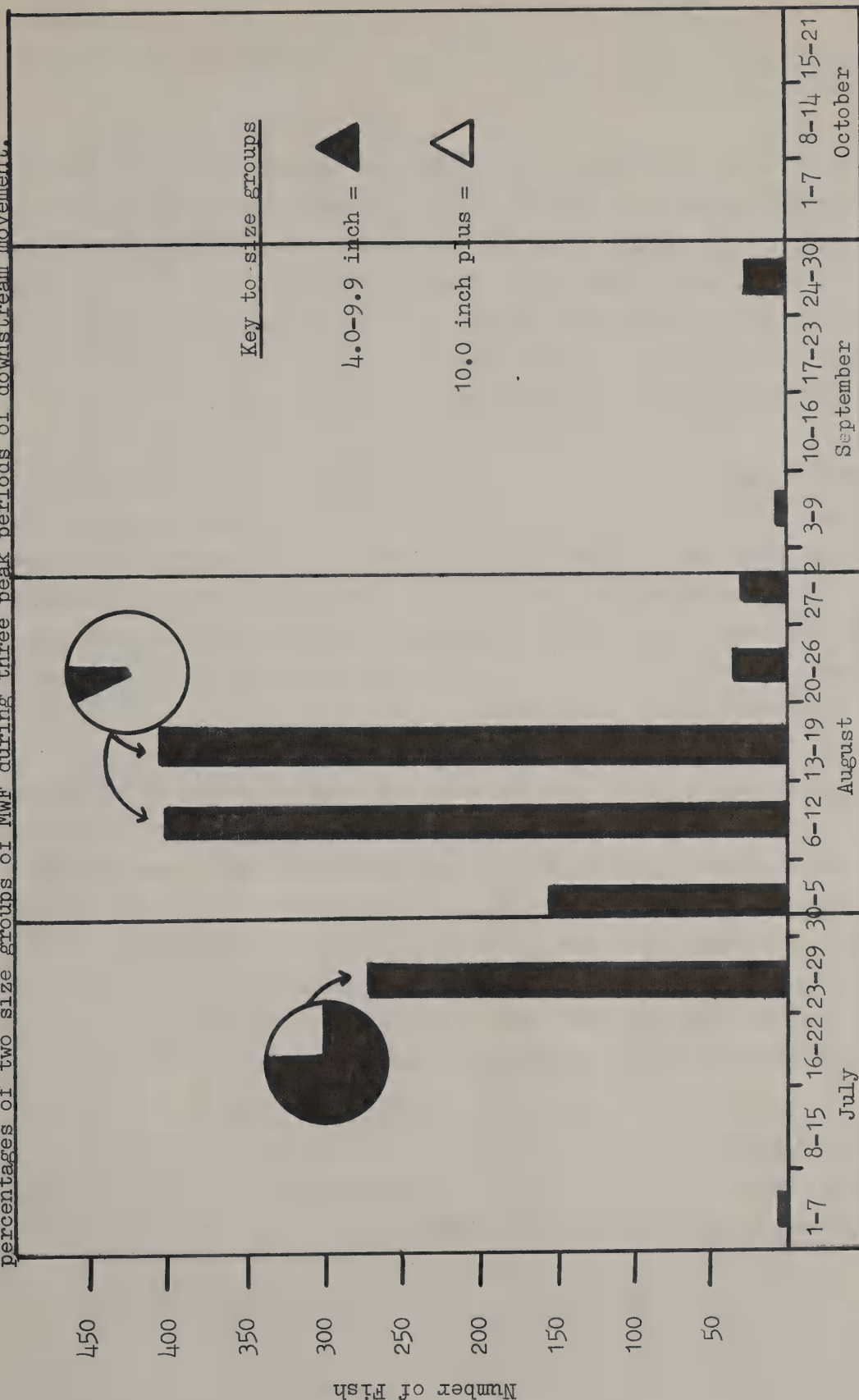
In general, the eastern side of the North Fork drainage differs in character from the western side. Most of the eastern drainages, except for Kishenehn and Starvation, have lakes which are warmer and many maintain populations of suckers. Therefore, studies done on the western drainages may not easily be extrapolated to those streams on the eastern side, with the exception of Starvation and Kishenehn Creeks.

### Redd Counts

Dolly Varden and cutthroat trout redds were studied in 1977 and 1978. Preliminary work consisted of walking down the creek bed looking for spawning areas. The object was to locate, mark, and count the redds. Redds were marked by driving a piece of metal re-bar into the gravel beside the spawning bed. Visual surveys for cutthroat redds were attempted in June, 1978 with limited success due to high water and turbidity.

During the 1977 field season, Whale, Shorty, Trail, and Red Meadow Creeks were surveyed for Dolly Varden redds. Gravel samples were taken from one redd in Whale Creek. In the Whale Creek drainage the majority of redds were found in the upper section surveyed that extends from the mouth of Shorty Creek downstream about three miles to the bridge on the Whale Buttes Road. Three redds were found in the lower part of Shorty Creek also. Eight

Figure 5: Numbers of downstream Mountain Whitefish migrants during 1977 in Big Creek as determined by downstream trapping and shocking 500 feet above the trap with circular representation of percentages of two size groups of MWF during three peak periods of downstream movement.



miles of Trail Creek were surveyed for redds. The majority was found in one section of stream for about a mile. Dolly Varden redds were found between the upper and lower bridges on Red Meadow Creek Road, a distance of about eight miles.

Portions of Whale Creek and all of Red Meadow and Trail Creeks were surveyed for Dolly Varden redds in 1978. Gravel samples were taken from four redds on Red Meadow Creek and two redds on Trail Creek. The majority of redds found was located in the same areas as the previous year. Some redds were found in the exact location in Whale Creek where redds were found in 1977. Dolly Varden spawners were collected in the same areas where redds were found during shocking operations on Trail Creek.

Measurements of redd length, width, depth, distance from nearest cover, and water velocity over the redd were noted for each gravel sample (Table 8). Length of redds varied from 1.5 to 5.0 feet. Widths were found between 1.8 and 3.0 feet and depths varied from 0.7 to 1.2 feet. Four redds sampled on Red Meadow Creek were consistently between 0.7 and 0.8 feet deep. No apparent trend can be seen for the recorded distances to the nearest cover, and velocities varied a great deal.

Gravel samples were analyzed with a graduated series of sieve sizes. Weight and volume of each of the eight gravel sizes were recorded. Percentages were calculated and graphed for the weights and volumes (Appendix VII). The most dominate gravel sizes for Dolly Varden redds were between one and two inches and between .0331 and .25 inches. However, the percent composition by weight varied widely. Analysis of percent composition by volume did not show any significant differences. Egg counts and weights determined from prespawning Dolly Varden natural mortalities are listed in Appendix VIII.

#### Age and Growth

Interpreting the life history of fish populations requires a determination of age structure and growth patterns. Dolly Varden and westslope

Table 8: Physical measurements of Dolly Varden redds at stream locations.

Creek	Location of Redd in Stream	Length (ft.)	Width (ft.)	Depth (ft.)	Distance to Cover (ft.)	Velocity at Head of Redd (ft. per sec.)
Red Meadow #1 1978	Right Bank	4.0	2.0	0.7	10	1.13
Red Meadow #2 1978	Center	5.0	2.0	0.8	24	0.40
Red Meadow #3 1978	Left Bank	3.0	2.0	0.8	24	----
Red Meadow #4 1978	Left Bank	1.5	1.8	0.7	1	0.22
Trail #1 1978	Center	4.8	3.0	1.2	19	1.87
Trail #2 1978	Left Bank	5.0	3.0	1.0	17	1.13
Whale #1 1977	Right Bank	3.3	2.0	0.7	11	1.19
Whale #2 1977	Right Bank	3.0	2.0	1.1	9	0.95
Shorty #1 1977	Right Bank	4.0	3.0	0.5	15	----
Shorty #2 1977	Left Bank	4.0	3.0	1.2	--	----

cutthroat age and growth data were obtained from analysis of circuli on scales and otoliths (ear bones). Otoliths were taken from inside the skull just behind the eye and scales were taken from fish between the dorsal fin and lateral line. Scales were used as the primary source of age and growth information. Each creek was treated as a separate population. Thirty scales were taken per inch group for both species. Otoliths were taken from 34 Dolly Varden spawning mortalities in 1977 and approximately 40 smaller Dolly Varden and cutthroat trout in 1978. This data is currently being analyzed and will be supplemented with age and growth information gathered in the next few seasons.

#### 1977 Special Season Creel Census

The regular 1977 fishing season for trout occurred from May 21 to November 30. A special season opened on Coal, Big, Whale, and Trail Creeks for public angling from May 21 through July 4. Prior to 1977 these streams were closed to angling for a 25-year period to protect Dolly Varden spawning runs. The special 1977 season was terminated a week early due to Dolly Varden movement into these creeks. A creel census was conducted during this time for recovering fish tagged in the lower Flathead River and recording information on movement. An angler check station was established on the North Fork River Road at Canyon Creek.

This check station was operated from 10 a.m. to 8 p.m. on weekends and holidays during the special season. Information collected from each angler included area fished, hours of fishing, and number of fish caught by species (Table 9). Data taken from fish caught included length, sex, gonad condition, and tag returns. Results of the census showed that the overall angler success rate was .29 fish per hour of fishing. A breakdown by species revealed a catch rate of .24 westslope cutthroat, .01 Dolly Varden, and .02 mountain whitefish per hour. Cutthroat were harvested in greatest numbers and the North Fork River totaled more anglers and hours fished than all tributaries combined.

Table 9: Summary of the 1977 special season creel census from May 21 to June 26.

Waters Fished	Number of Anglers	Hours Fished	Westslope adults	Cutthroat juveniles	Dolly Varden	Mountain Whitefish	Tag Returns
North Fork River	630	2158	145	399	24	47	6
Big Creek	140	296	2	18	0	21	0
Coal Creek	65	186	0	25	0	0	1
Whale Creek	42	122	0	6	0	0	0
Trail Creek	27	63	0	33	1	0	0
Hay Creek	13	80	0	75	0	0	0
Red Meadow Creek	12	37	2	17	0	0	0
Camas Creek	11	35	0	0	0	0	0
Moose Creek	8	15	0	1	0	0	0
Canyon Creek	5	14	0	0	0	0	0
TOTAL	953	3006	149	574	25	68	8

The creel census produced six tag returns in the North Fork River itself and one return on Coal Creek. An authenticated fisherman's report also showed a tag return on Whale Creek. These returns indicate that adult westslope cutthroat trout from Flathead Lake spawn in both Coal and Whale Creeks.

## SELECTED REFERENCES

- Davies, R.W., and Thompson, G.W. 1976. Movements of Mountain Whitefish (Prosopium williamsoni) in the Sheep River Watershed, Alberta. Journal of Fisheries Research Board of Canada. 33 (11): 2395 - 2401.
- Flathead Drainage 208 Project. 1976 Water Quality North Fork Baseline. 89pp.
- Huston, J. E., and May, Bruce. 1975. Status of Fish Populations in the Kootenai River Below Libby Dam Following Regulation of River. Kootenai River Fisheries Investigations Final Job Completion Report, Contract No. DAC 67-73-C-0003, Montana Fish and Game Dept. 28pp.
- Jenkins, Hanley F. 1977. Upper Flathead River Basin Study. Montana Dept. of Natural Resources and Conservation, Water Resources Division. 135pp.
- Knapton, J. R. 1978. Evaluation and Correlation of Water-Quality Data for the North Fork Flathead River, Northwest Montana. U. S. Geological Survey, Water Resources Investigation. Vol. 3: 102.
- Stanford, J. A. 1975. Ecological Studies of Plecoptera in the Upper Flathead Rivers, Montana. Ph.D. dissertation, University of Utah. Salt Lake City. 241pp.
- U. S. Fish and Wildlife Service. 1977. Fishery Investigations Glacier National Park 1977 Progress Document. 322pp.



APPENDIX I:

North Fork Stream Discharges  
from Price Current Meter Measurements

North Fork Stream Discharges \*

Streams Measured	1978		1976		1975	
	8/16	10/27	9/23	7/14	9/9	10/14
Trail Creek	75.90	57.56		138.06	70.72	72.45
Whale Creek	122.92	66.59			100.24	91.61
Coal Creek	78.71	46.76			86.44	78.63
Hay Creek	38.22	14.86		86.41	26.20	28.17
Red Meadow Creek	24.64	17.81	13.33	83.57	22.55	20.04
Moose Creek	11.74	6.68		28.05	11.05	7.07
Moran Creek	7.40	5.03		16.83	7.25	11.07
Teepee Creek	1.69	1.13		7.37	.96	1.01
Big Creek	262.89 **					18.85

\* Measured in cubic ft./second at North Fork Road

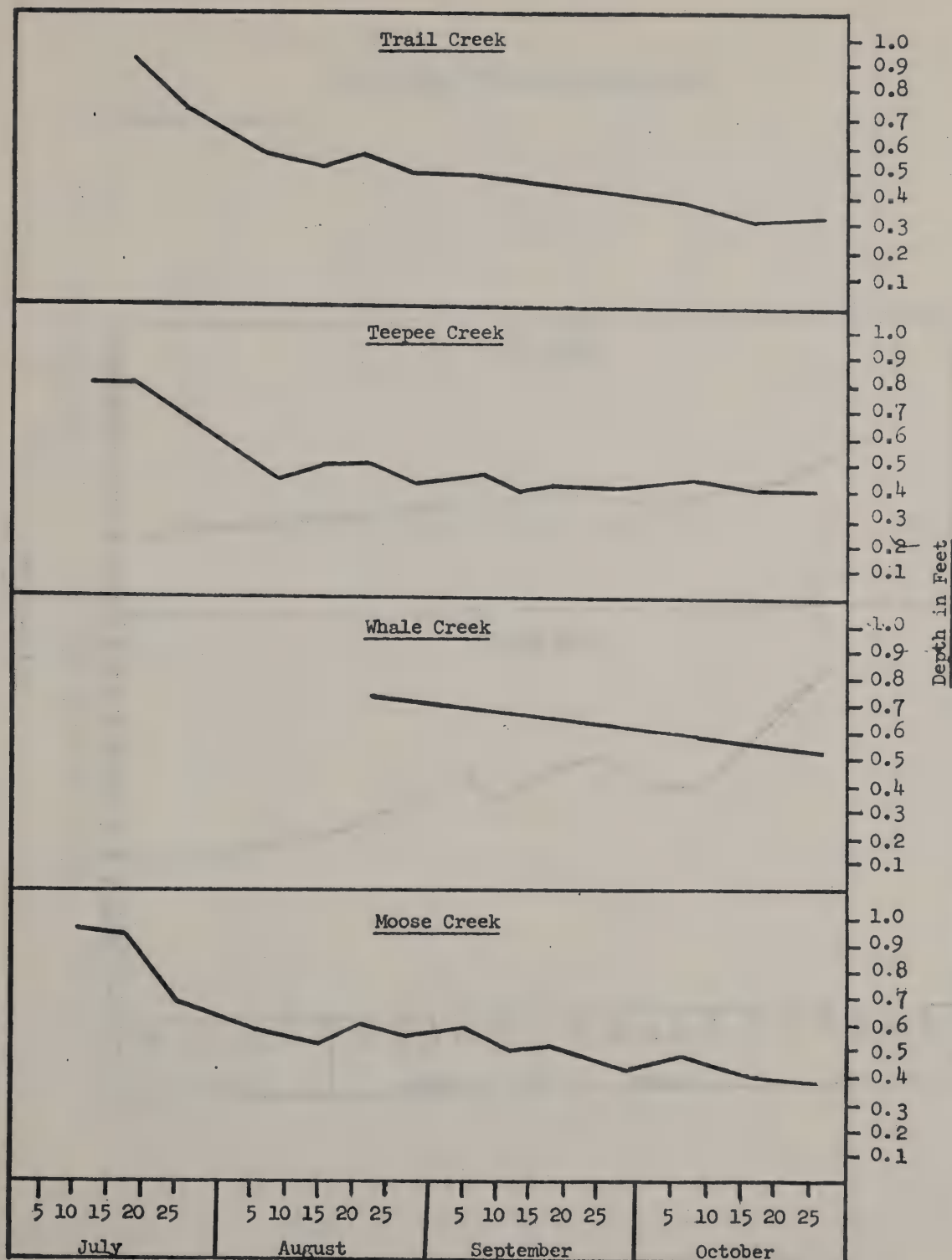
\*\* Information received from the U.S. Forest Service

APPENDIX II:

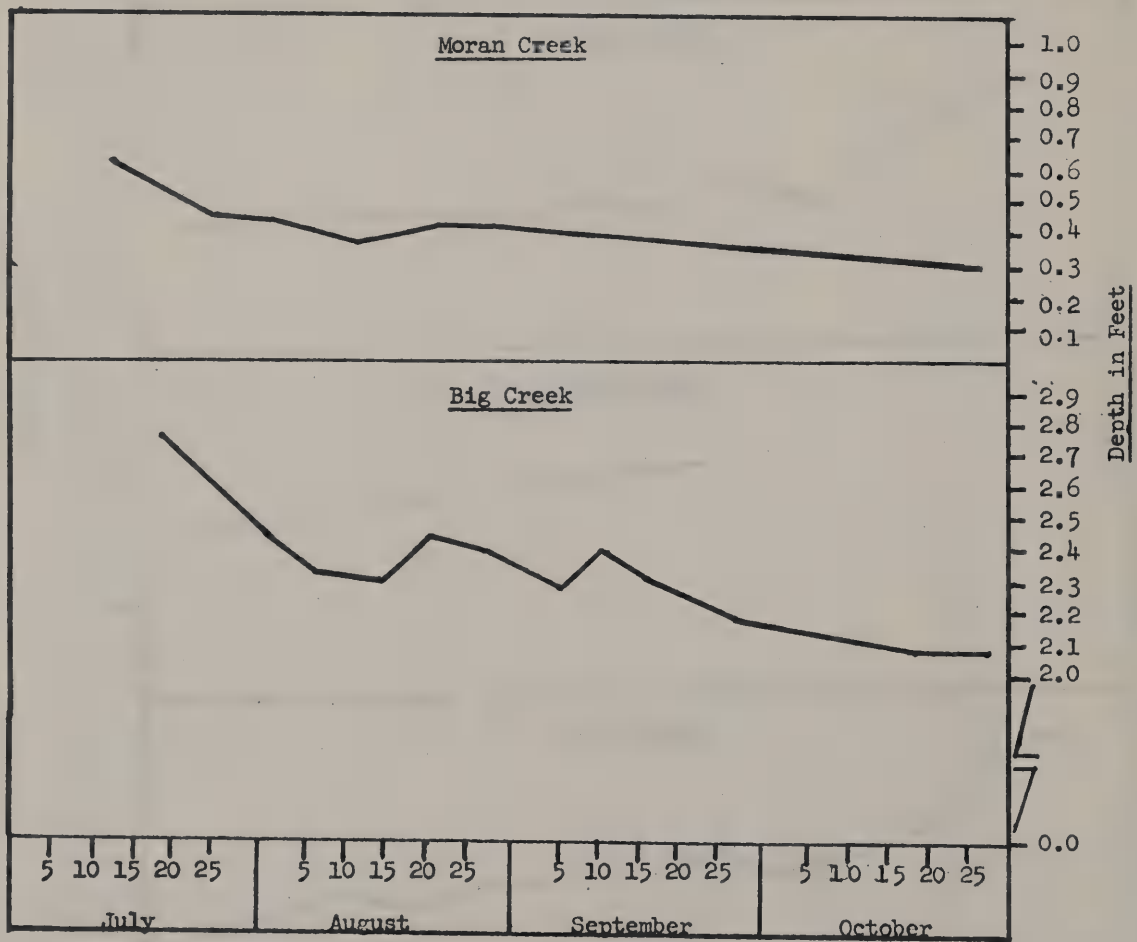
Weekly Depth Readings from Stream Gauges  
for 1978



Stream Gauge Depth Readings - 1978



Stream Gauge Depth Readings - 1978



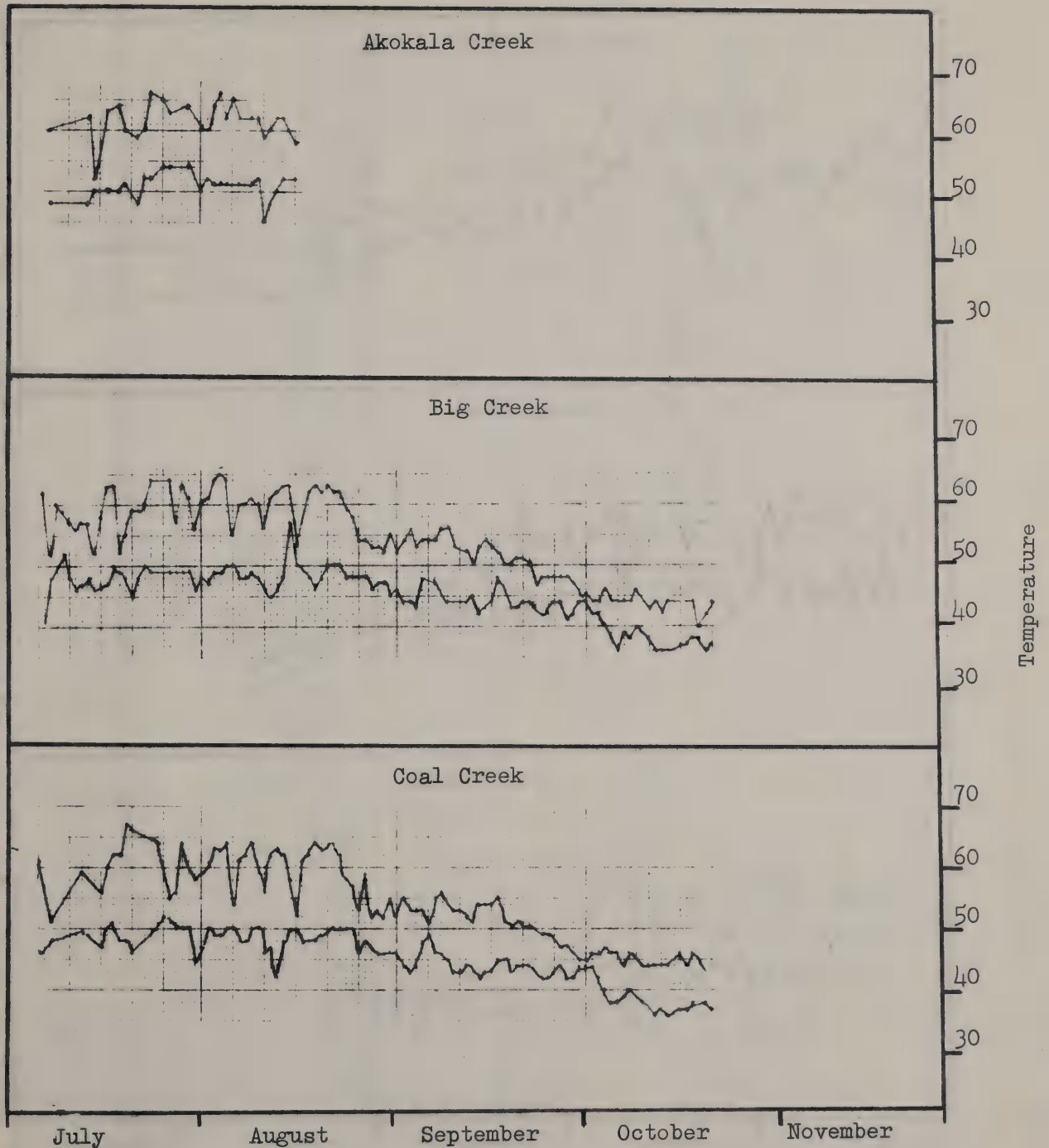
APPENDIX III:

Daily Maximum - Minimum Temperatures  
for 1977 and 1978



Maximum - Minimum Temperatures - 1977

recorded in degrees Fahrenheit

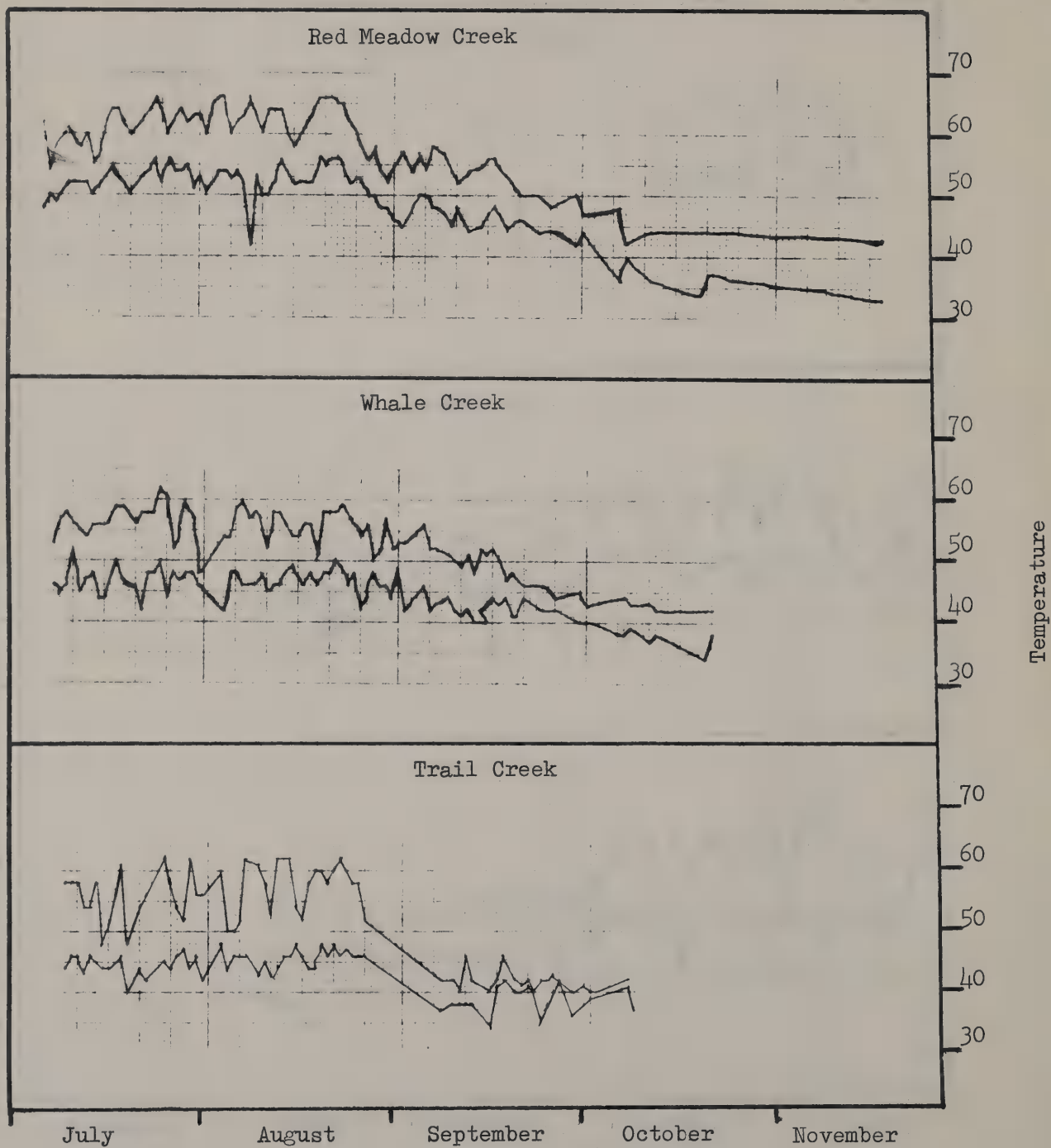


Upper line - maximum temperature

Lower line - minimum temperature - 35

Maximum - Minimum Temperatures - 1977

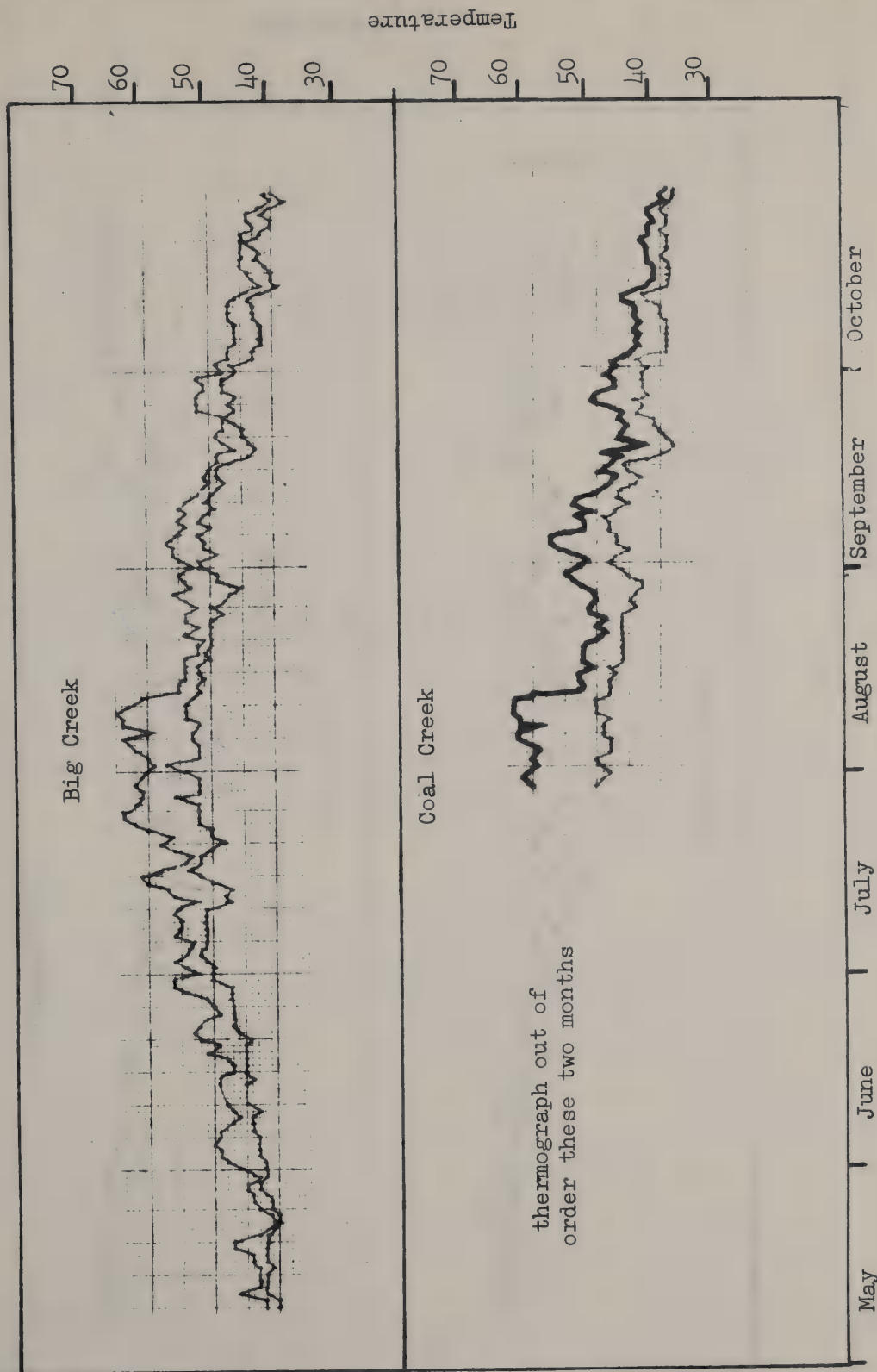
recorded in degrees Fahrenheit



Upper line - maximum temperature

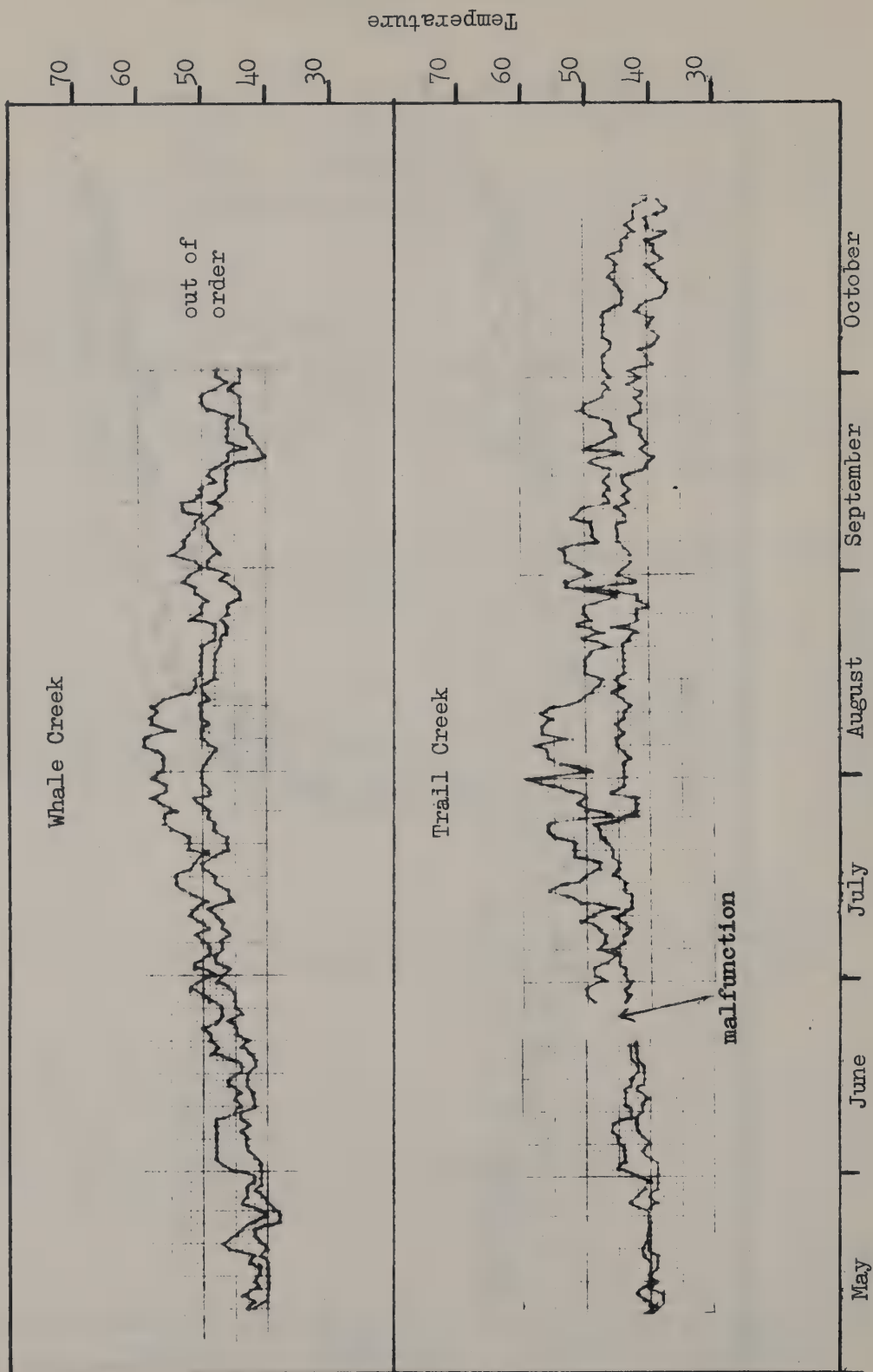
Lower line - minimum temperature - 36 -

Maximum - Minimum Temperatures - 1978  
 recorded in degrees Fahrenheit



Upper line - maximum temperature  
 Lower line - minimum temperature

Maximum - Minimum Temperatures - 1978  
 recorded in degrees Fahrenheit



Upper line - maximum temperature  
 Lower line - minimum temperature

APPENDIX IV:

Individual Habitat Stations Data  
for Surveys Completed in 1978



# STREAM HABITAT INVENTORY

Moose Creek, Flathead County, Montana  
T.36N., R.21W., Section 31  
July 17, 1978

## STATION 1

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	58.8
boulder	29.4
rubble	29.4
gravel	29.4
sand-silt	0
other	11.7
Stream bank Environment	37.5

### Cross Section B - %

Pool rating	74.1
Pool structure	74.1
Stream bottom	85.2
boulder	0
rubble	48.2
gravel	37.0
sand-silt	14.8
other	0
Stream bank Environment	25.0

### Cross Section C - %

Pool rating	0
Pool structure	0
Stream bottom	62.5
boulder	16.6
rubble	54.2
gravel	8.3
sand-silt	4.2
other	16.6
Stream bank Environment	31.2

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	73.0
boulder	5.4
rubble	62.2
gravel	10.8
sand-silt	0
other	21.6
Stream bank Environment	50.0

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	68.7
boulder	0
rubble	0
gravel	68.8
sand-silt	12.5
other	6.2
Stream bank Environment	25.0

### Station Parameters

Gradient	1% - 2%
Average Velocity	1.78 ft./second
Average Flow	25.83 cubic ft./second
Average Width	24 ft.
Land Use	Timber, recreational
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Moose Creek, Flathead County, Montana  
T.36N., R.22W., Section 34  
August 7, 1978

## STATION 2

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	61.9
boulder	9.5
rubble	52.4
gravel	9.5
sand-silt	14.3
other	14.3
Stream bank Environment	87.5

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	22.6
boulder	0
rubble	19.3
gravel	3.2
sand-silt	6.4
other	14.3
Stream bank Environment	87.5

### Cross Section C - %

Pool rating	0
Pool structure	0
Stream bottom	37.5
boulder	0
rubble	0
gravel	37.5
sand-silt	0
other	62.5
Stream bank Environment	68.75

### Cross Section D - %

Pool rating	42.9
Pool structure	0
Stream bottom	46.4
boulder	0
rubble	39.3
gravel	7.1
sand-silt	7.1
other	46.4
Stream bank Environment	37.5

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	25.0
boulder	7.1
rubble	10.7
gravel	14.3
sand-silt	42.8
other	25.0
Stream bank Environment	62.5

### Station Parameters

Gradient	1% - 2%
Average Velocity	Not available
Average Flow	Not available
Average Width	18 ft.
Land Use	Timber, recreational
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Moose Creek, Flathead County, Montana  
T.36N., R.22W., Section 5  
July 18, 1978

## STATION 3

### Cross Section A - %

Pool rating	85.7
Pool structure	85.7
Stream bottom	82.9
boulder	0
rubble	42.8
gravel	40.0
sand-silt	17.1
other	0
Stream bank Environment	37.5

### Cross Section B - %

Pool rating	86.9
Pool structure	86.9
Stream bottom	65.2
boulder	8.7
rubble	65.2
gravel	0
sand-silt	26.1
other	0
Stream bank Environment	37.5

### Cross Section C - %

Pool rating	0
Pool structure	0
Stream bottom	47.4
boulder	0
rubble	47.4
gravel	0
sand-silt	0
other	52.6
Stream bank Environment	43.8

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	20.0
boulder	0
rubble	0
gravel	20.0
sand-silt	25.0
other	55.0
Stream bank Environment	37.5

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	89.3
boulder	0
rubble	50.0
gravel	39.3
sand-silt	7.1
other	3.6
Stream bank Environment	43.7

### Station Parameters

Gradient	1% - 2%
Average Velocity	2.85 ft./second
Average Flow	38.4 cubic ft./second
Average Width	25 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Some braiding

# STREAM HABITAT INVENTORY

Moose Creek, Flathead County, Montana  
T.35N., R.22W., Section 5  
July 27, 1978

## STATION 4

### Cross Section A - %

Pool rating	100.0
Pool structure	100.0
Stream bottom	50.0
boulder	50.0
rubble	7.1
gravel	42.8
sand-silt	0
other	0
Stream bank Environment	62.5

### Cross Section B - %

Pool rating	90.0
Pool structure	20.0
Stream bottom	40.0
boulder	5.0
rubble	20.0
gravel	20.0
sand-silt	5.0
other	50.0
Stream bank Environment	87.5

### Cross Section C - %

Pool rating	53.3
Pool structure	53.3
Stream bottom	26.6
boulder	0
rubble	10.0
gravel	16.7
sand-silt	16.7
other	56.7
Stream bank Environment	62.5

### Cross Section B - %

Pool rating	45.8
Pool structure	0
Stream bottom	12.0
boulder	6.0
rubble	7.2
gravel	4.8
sand-silt	77.1
other	4.8
Stream bank Environment	87.5

### Cross Section E - %

Pool rating	44.4
Pool structure	44.4
Stream bottom	33.3
boulder	59.3
rubble	25.9
gravel	7.4
sand-silt	0
other	7.4
Stream bank Environment	37.5

### Station Parameters

Gradient	1% - 2%
Average Velocity	2.16 ft./second
Average Flow	22.35 cubic ft./second
Average Width	35 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Some braiding

# STREAM HABITAT INVENTORY

Moose Creek, Flathead County, Montana  
T.35N., R.22W., Section 2  
August 3, 1978

## STATION 5

### Cross Section A - %

Pool rating	72.0
Pool structure	0
Stream bottom	48.0
boulder	24.0
rubble	48.0
gravel	0
sand-silt	8.0
other	20.0
Stream bank Environment	37.5

### Cross Section B - %

Pool rating	90.0
Pool structure	0
Stream bottom	65.0
boulder	25.0
rubble	65.0
gravel	0
sand-silt	5.0
other	5.0
Stream bank Environment	37.5

### Cross Section C - %

Pool rating	29.6
Pool structure	0
Stream bottom	85.2
boulder	7.4
rubble	66.6
gravel	18.5
sand-silt	0
other	7.4
Stream bank Environment	25.0

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	36.0
boulder	0
rubble	16.0
gravel	20.0
sand-silt	0
other	64.0
Stream bank Environment	25.0

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	41.4
boulder	0
rubble	17.2
gravel	24.1
sand-silt	6.9
other	51.7
Stream bank Environment	25.0

### Station Parameters

Gradient	< 1%
Average Velocity	1.22 ft./second
Average Flow	11.59 cubic ft./second
Average Width	25 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Trail Creek, Flathead County, Montana  
T.37N., R.22W., Section 29  
October 16, 1978

## STATION 1

### Cross Section A - %

Pool rating	11.5
Pool structure	0
Stream bottom	86.5
boulder	7.7
rubble	86.5
gravel	0
sand-silt	5.8
other	0
Stream bank Environment	75.0

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	66.6
boulder	33.3
rubble	66.6
gravel	0
sand-silt	0
other	0
Stream bank Environment	75.0

### Cross Section C - %

Pool rating	42.1
Pool structure	0
Stream bottom	52.6
boulder	15.8
rubble	52.6
gravel	0
sand-silt	7.9
other	23.7
Stream bank Environment	75.0

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	86.6
boulder	14.0
rubble	78.0
gravel	0
sand-silt	0
other	8.0
Stream bank Environment	75.0

### Cross Section E - %

Pool rating	82.3
Pool structure	0
Stream bottom	62.7
boulder	9.8
rubble	60.8
gravel	2.0
sand-silt	13.7
other	13.7
Stream bank Environment	75.0

## Station Parameters

Gradient	<1%
Average Velocity	1.5 ft./second
Average Flow	8.7 cubic ft./second
Average Width	40 ft.
Land Use	Commercial timber, recreational
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Trail Creek, Flathead County, Montana  
T.37N., R.22W., Section 28  
October 16, 1978

## STATION 2

### Cross Section A - %

Pool rating	26.9
Pool structure	0
Stream bottom	86.5
boulder	48.0
rubble	9.6
gravel	11.5
sand-silt	1.9
other	19.2
Stream bank Environment	75.0

### Cross Section B - %

Pool rating	49.1
Pool structure	0
Stream bottom	66.6
boulder	15.8
rubble	63.2
gravel	14.0
sand-silt	3.5
other	0
Stream bank Environment	100.0

### Cross Section C - %

Pool rating	10.8
Pool structure	0
Stream bottom	72.9
boulder	27.0
rubble	70.3
gravel	2.7
sand-silt	0
other	0
Stream bank Environment	75.0

### Cross Section D - %

Pool rating	23.5
Pool structure	23.5
Stream bottom	86.3
boulder	7.8
rubble	72.5
gravel	13.7
sand-silt	5.8
other	0
Stream bank Environment	75.0

### Cross Section E - %

Pool rating	42.6
Pool structure	0
Stream bottom	37.7
boulder	11.5
rubble	21.3
gravel	16.4
sand-silt	19.7
other	31.2
Stream bank Environment	100.0

### Station Parameters

Gradient	<1%
Average Velocity	2.2 ft./second
Average Flow	56.25 cubic ft./second
Average Width	42 ft.
Land Use	Commercial timber, recreational
Ownership	Private
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Trail Creek, Flathead County, Montana  
T.37N., R.22W., Section 33  
October 18, 1978

## STATION 3

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	55.3
boulder	19.2
rubble	48.9
gravel	6.4
sand-silt	0
other	25.5
Stream bank Environment	100.0

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	50.0
boulder	22.2
rubble	50.0
gravel	0
sand-silt	0
other	27.8
Stream bank Environment	75.0

### Cross Section C - %

Pool rating	30.8
Pool structure	0
Stream bottom	76.9
boulder	12.8
rubble	69.2
gravel	7.7
sand-silt	0
other	10.26
Stream bank Environment	100.0

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	78.8
boulder	11.5
rubble	78.8
gravel	0
sand-silt	5.8
other	3.8
Stream bank Environment	100.0

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	88.7
boulder	7.6
rubble	88.7
gravel	0
sand-silt	1.9
other	1.9
Stream bank Environment	75.0

### Station Parameters

Gradient	<1%
Average Velocity	1.21 ft./second
Average Flow	53.08 cubic ft./second
Average Width	48 ft.
Land Use	Recreation, timber
Ownership	Private
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Trail Creek, Flathead County, Montana  
T.37N., R.22W., Section 34  
October 19, 1978

## STATION 4

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	61.7
boulder	14.7
rubble	61.7
gravel	0
sand-silt	0
other	23.5
Stream bank Environment	68.7

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	48.8
boulder	39.0
rubble	48.8
gravel	0
sand-silt	0
other	12.2
Stream bank Environment	37.5

### Cross Section C - %

Pool rating	69.6
Pool structure	0
Stream bottom	47.8
boulder	10.8
rubble	28.3
gravel	19.6
sand-silt	23.9
other	17.4
Stream bank Environment	100.0

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	75.0
boulder	13.9
rubble	58.3
gravel	16.7
sand-silt	0
other	11.1
Stream bank Environment	62.5

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	12.0
boulder	8.0
rubble	12.0
gravel	0
sand-silt	8.0
other	72.0
Stream bank Environment	31.2

### Station Parameters

Gradient	<1%
Average Velocity	1.1 ft./second
Average Flow	56.67 cubic ft./second
Average Width	36 ft.
Land Use	Recreation, timber
Ownership	Private
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Trail Creek, Flathead County, Montana  
T.37N., R.22W., Section 34  
October 19, 1978

## STATION 5

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	56.8
boulder	0
rubble	19.6
gravel	37.2
sand-silt	13.7
other	29.4
Stream bank Environment	37.5

### Cross Section B - %

Pool rating	84.8
Pool structure	0
Stream bottom	57.6
boulder	0
rubble	51.5
gravel	6.1
sand-silt	36.4
other	6.1
Stream bank Environment	37.5

### Cross Section C - %

Pool rating	53.3
Pool structure	0
Stream bottom	91.1
boulder	2.2
rubble	33.3
gravel	57.8
sand-silt	6.6
other	0
Stream bank Environment	25.0

### Cross Section D - %

Pool rating	78.4
Pool structure	0
Stream bottom	39.2
boulder	2.0
rubble	7.8
gravel	31.4
sand-silt	15.7
other	43.1
Stream bank Environment	56.2

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	38.5
boulder	0
rubble	30.8
gravel	7.7
sand-silt	7.7
other	53.8
Stream bank Environment	37.5

### Station Parameters

Gradient	< 1%
Average Velocity	1.56 ft./second
Average Flow	50.71 cubic ft./second
Average Width	44 ft.
Land Use	Recreation
Ownership	Private
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Braided

# STREAM HABITAT INVENTORY

Trail Creek, Flathead County, Montana  
T.37N., R.22W., Section 35  
October 19, 1978

## STATION 6

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	66.6
boulder	30.6
rubble	61.1
gravel	5.5
sand-silt	2.8
other	0
Stream bank Environment	50.0

### Cross Section B - %

Pool rating	9.7
Pool structure	0
Stream bottom	9.2
boulder	9.7
rubble	85.4
gravel	4.9
sand-silt	0
other	4.9
Stream bank Environment	31.2

### Cross Section C - %

Pool rating	13.9
Pool structure	0
Stream bottom	86.0
boulder	11.6
rubble	76.7
gravel	9.3
sand-silt	0
other	2.3
Stream bank Environment	31.2

### Cross Section D - %

Pool rating	31.6
Pool structure	0
Stream bottom	68.4
boulder	15.8
rubble	60.5
gravel	7.9
sand-silt	5.3
other	10.5
Stream bank Environment	31.2

### Cross Section E - %

Pool rating	35.5
Pool structure	0
Stream bottom	82.2
boulder	8.9
rubble	68.9
gravel	13.3
sand-silt	13.3
other	8.9
Stream bank Environment	50.0

### Station Parameters

Gradient	1%
Average Velocity	1.79 ft./second
Average Flow	55.86 cubic ft./second
Average Width	40 ft.
Land Use	Recreation
Ownership	Private
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Non-braided

# STREAM HABITAT INVENTORY

Hay Creek, Flathead County, Montana  
T.35N., R.21W., Section 34  
August 28, 1978

## STATION 1

### Cross Section A - %

Pool rating	34.5
Pool structure	0
Stream bottom	17.2
boulder	13.8
rubble	6.9
gravel	10.3
sand-silt	6.9
other	62.1
Stream bank Environment	50.0

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	15.8
boulder	0
rubble	5.3
gravel	10.5
sand-silt	21.1
other	63.2
Stream bank Environment	50.0

### Cross Section C - %

Pool rating	0
Pool structure	0
Stream bottom	51.3
boulder	0
rubble	12.8
gravel	38.5
sand-silt	10.3
other	38.5
Stream bank Environment	93.7

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	83.0
boulder	6.4
rubble	76.6
gravel	6.4
sand-silt	0
other	10.6
Stream bank Environment	37.5

### Cross Section E - %

Pool rating	26.1
Pool structure	0
Stream bottom	30.4
boulder	8.7
rubble	30.4
gravel	0
sand-silt	39.1
other	21.7
Stream bank Environment	31.3

### Station Parameters

Gradient	1%
Average Velocity	1.28 ft./second
Average Flow	31.12 cubic ft./second
Average Width	40 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Some braiding

# STREAM HABITAT INVENTORY

Hay Creek, Flathead County, Montana  
T.35N., R.21W., Section 30  
August 28, 1978

## STATION 2

### Cross Section A - %

Pool rating	92.3
Pool structure	92.3
Stream bottom	65.4
boulder	0
rubble	23.1
gravel	42.3
sand-silt	26.9
other	0
Stream bank Environment	25.0

### Cross Section B - %

Pool rating	35.9
Pool structure	35.9
Stream bottom	56.4
boulder	5.1
rubble	51.3
gravel	5.1
sand-silt	2.5
other	35.9
Stream bank Environment	87.5

### Cross Section C - %

Pool rating	19.6
Pool structure	19.6
Stream bottom	19.6
boulder	19.6
rubble	13.7
gravel	5.9
sand-silt	1.9
other	58.8
Stream bank Environment	87.5

### Cross Section D - %

Pool rating	50.0
Pool structure	50.0
Stream bottom	57.1
boulder	28.6
rubble	32.1
gravel	25.0
sand-silt	14.3
other	0
Stream bank Environment	62.5

### Cross Section E - %

Pool rating	13.3
Pool structure	0
Stream bottom	30.0
boulder	0
rubble	16.6
gravel	13.3
sand-silt	6.6
other	63.3
Stream bank Environment	87.5

### Station Parameters

Gradient	1%
Average Velocity	1.39 ft./second
Average Flow	29.69 cubic ft./second
Average Width	35 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Braided

# STREAM HABITAT INVENTORY

Hay Creek, Flathead County, Montana  
T.35N., R.21W., Section 28  
August 28, 1978

## STATION 4

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	90.0
boulder	10.0
rubble	60.0
gravel	30.0
sand-silt	0
other	0
Stream bank Environment	50.0

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	0
boulder	0
rubble	0
gravel	0
sand-silt	0
other	100.0
Stream bank Environment	62.5

### Cross Section C - %

Pool rating	96.5
Pool structure	96.5
Stream bottom	72.4
boulder	0
rubble	34.5
gravel	37.9
sand-silt	20.7
other	6.9
Stream bank Environment	68.7

### Cross Section D - %

Pool rating	69.6
Pool structure	0
Stream bottom	26.1
boulder	0
rubble	0
gravel	26.1
sand-silt	39.1
other	34.8
Stream bank Environment	62.5

### Cross Section E - %

Pool rating	80.0
Pool structure	80.0
Stream bottom	84.0
boulder	0
rubble	0
gravel	84.0
sand-silt	8.0
other	8.0
Stream bank Environment	87.5

### Station Parameters

Gradient	1%
Average Velocity	1.07 ft./second
Average Flow	11.73 cubic ft./second
Average Width	23 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	braided

# STREAM HABITAT INVENTORY

Hay Creek, Flathead County, Montana  
T.35N., R.21W., Section 32  
August 28, 1978

## STATION 5

### Cross Section A - %

Pool rating	0
Pool structure	0
Stream bottom	13.3
boulder	0
rubble	0
gravel	13.3
sand-silt	6.6
other	80.0
Stream bank Environment	25.0

### Cross Section B - %

Pool rating	0
Pool structure	0
Stream bottom	0
boulder	0
rubble	0
gravel	0
sand-silt	5.5
other	94.4
Stream bank Environment	37.5

### Cross Section C - %

Pool rating	44.4
Pool structure	0
Stream bottom	88.9
boulder	0
rubble	61.1
gravel	27.8
sand-silt	0
other	11.1
Stream bank Environment	93.7

### Cross Section D - %

Pool rating	0
Pool structure	0
Stream bottom	90.9
boulder	9.1
rubble	81.8
gravel	9.1
sand-silt	0
other	0
Stream bank Environment	68.7

### Cross Section E - %

Pool rating	0
Pool structure	0
Stream bottom	42.8
boulder	57.1
rubble	42.8
gravel	0
sand-silt	0
other	0
Stream bank Environment	50.0

### Station Parameters

Gradient	1%
Average Velocity	.57 ft./second
Average Flow	4.63 cubic ft./second
Average Width	15 ft.
Land Use	Timber, recreation
Ownership	Federal - Dept. of Agriculture
Access	Road
Aquatic Vegetation	Algae
Stream Channel	Braided

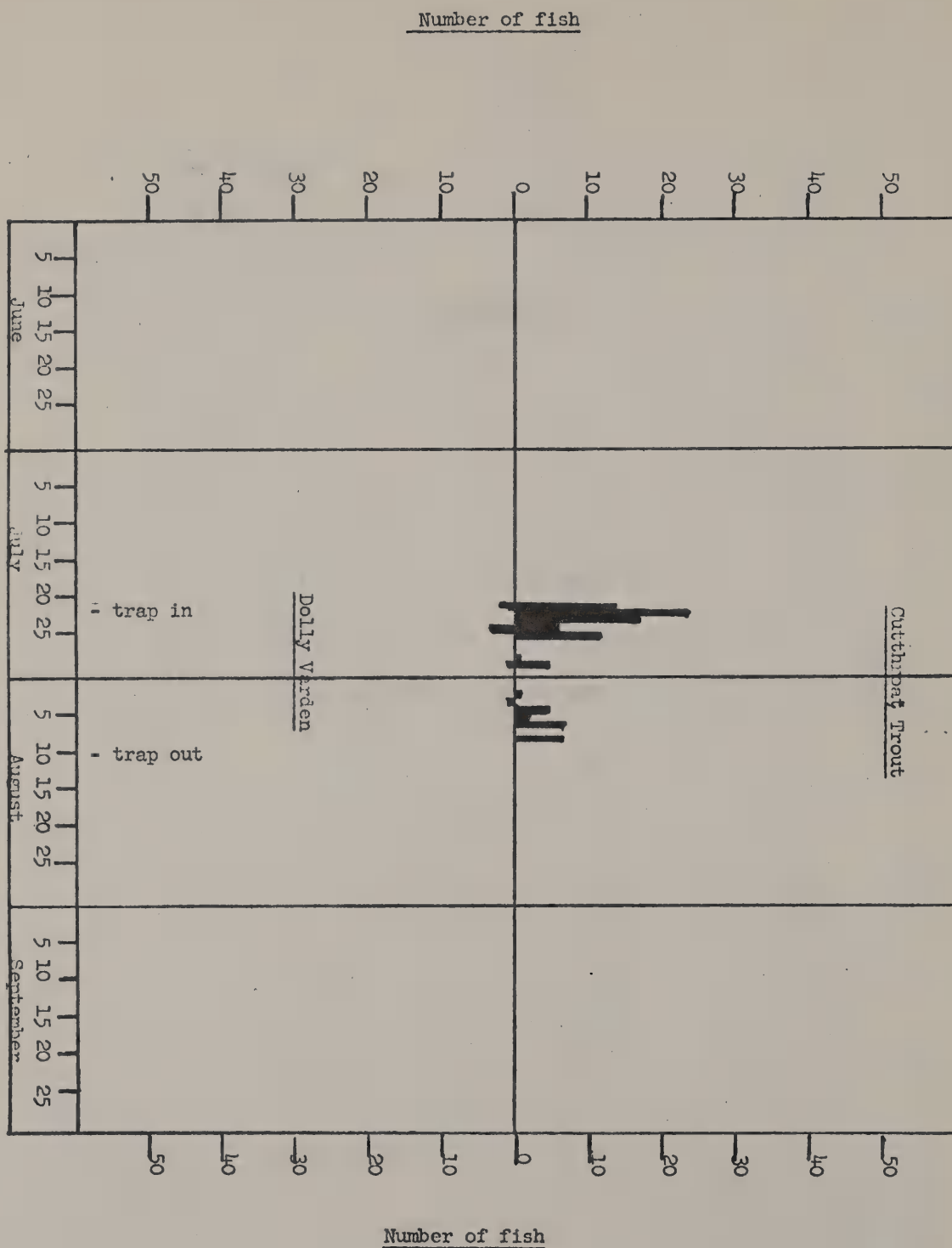


APPENDIX V:

Daily Trap Catch of Emmigrating  
Juvenile Dolly Varden and Westslope Cutthroat  
in North Fork Tributaries

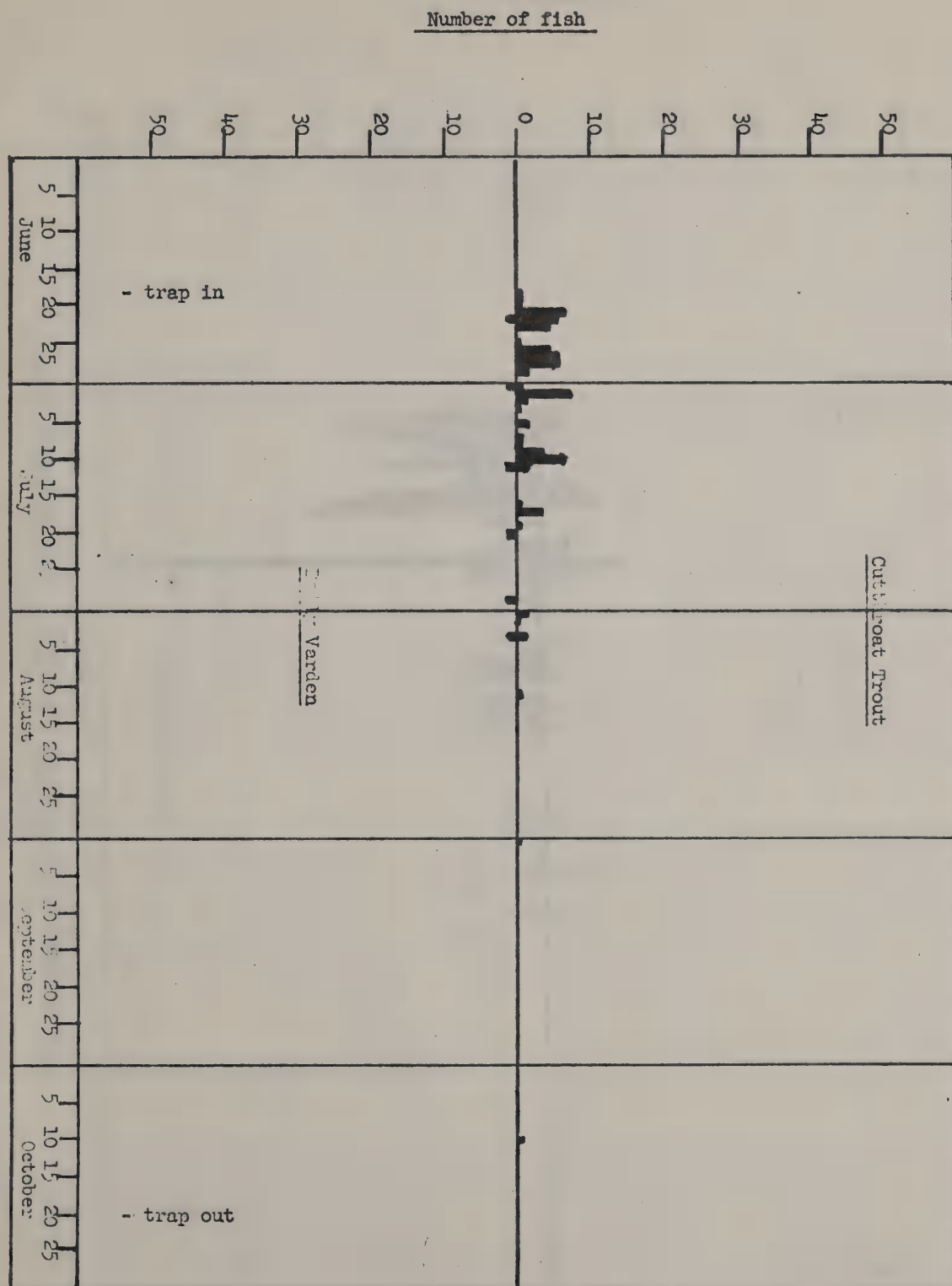
Long-term Trap Catch of Juvenile Dolly Varden & Cutthroat Trout

at Red Willow Creek - 1976



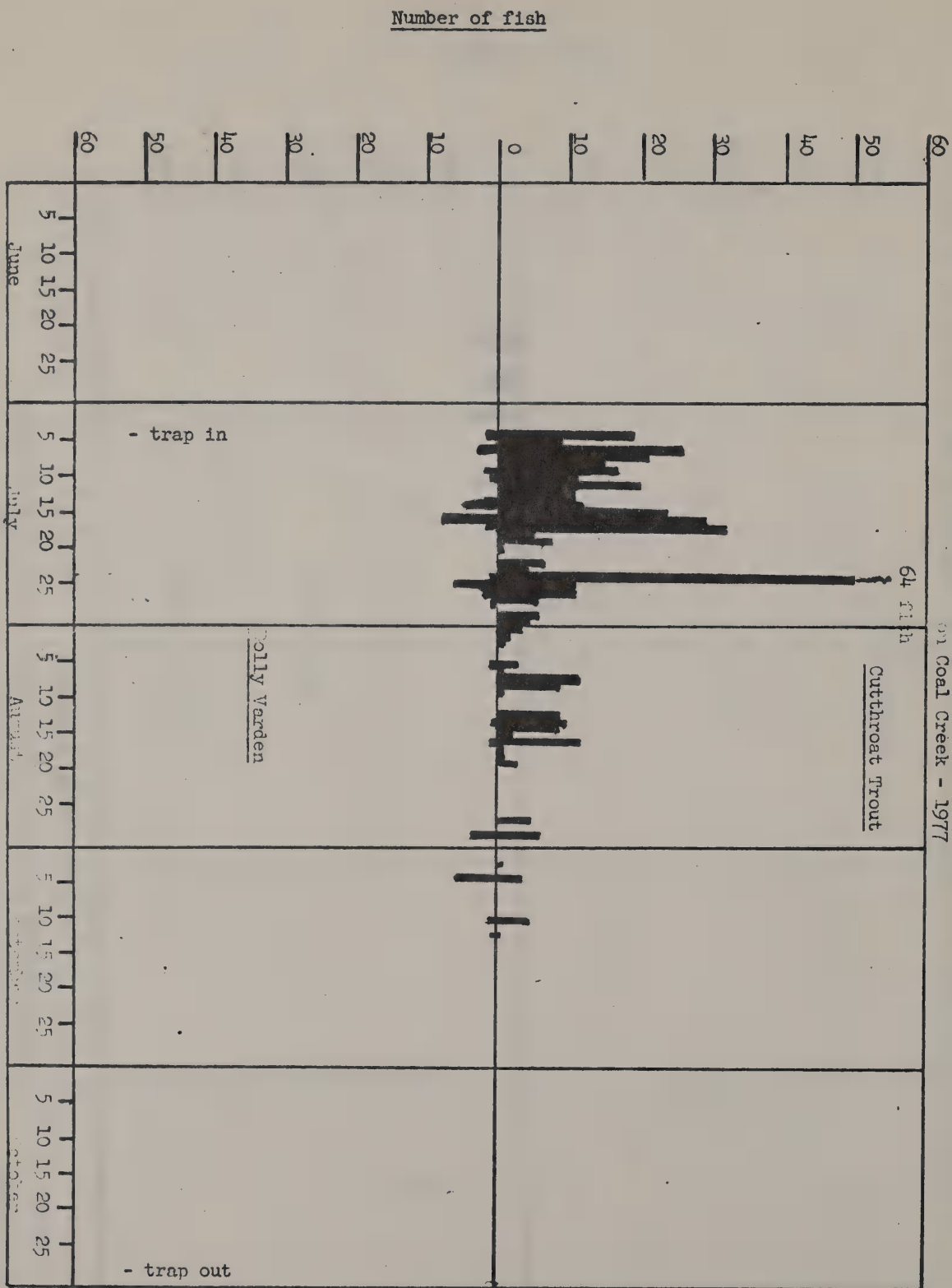
Downstream Trap Catch of Juvenile Dolly Varden & Cutthroat Trout

at Red Meadow Creek - 1977

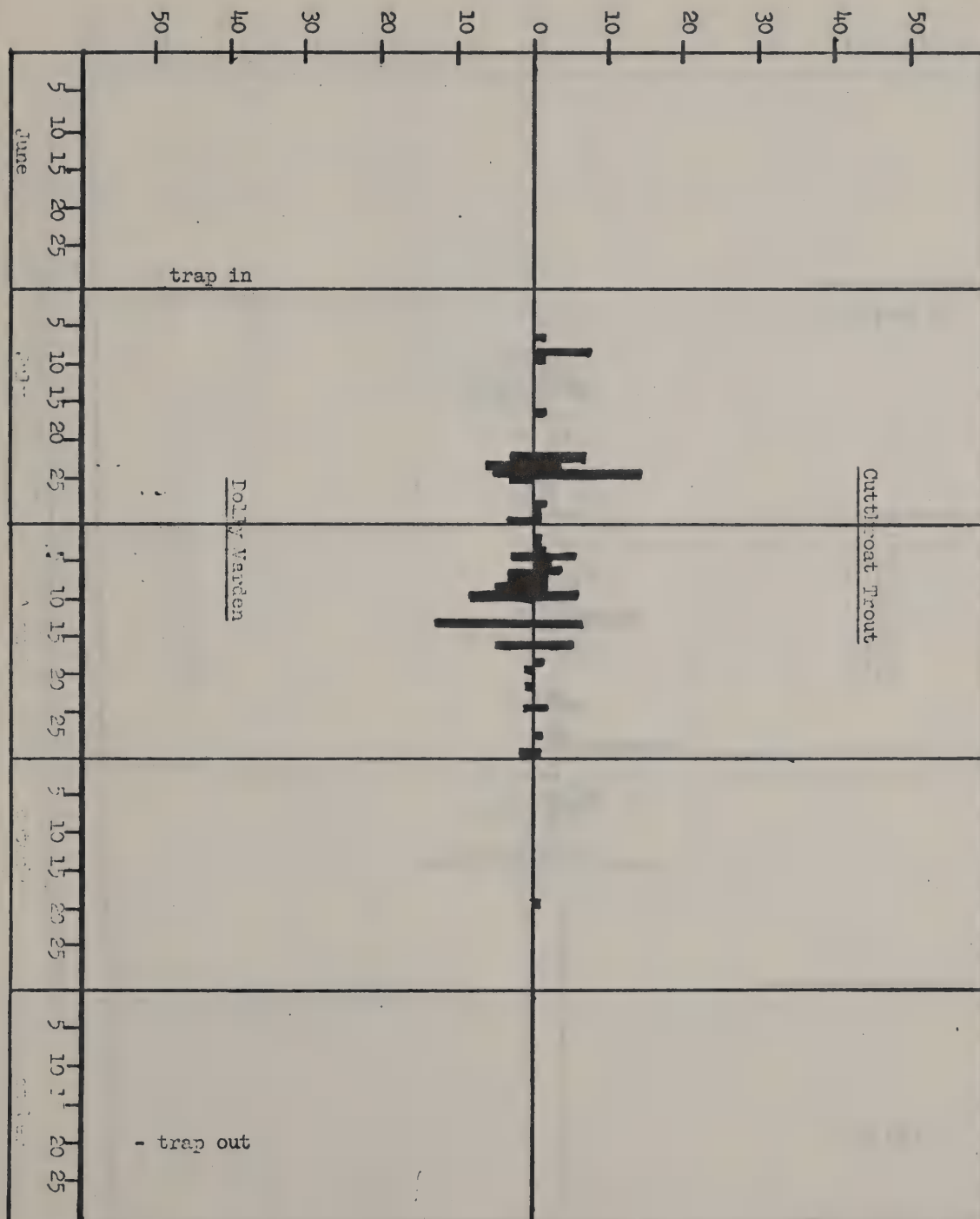


Downstream Trap Catch of Juvenile Dolly Varden & Cutthroat Trout

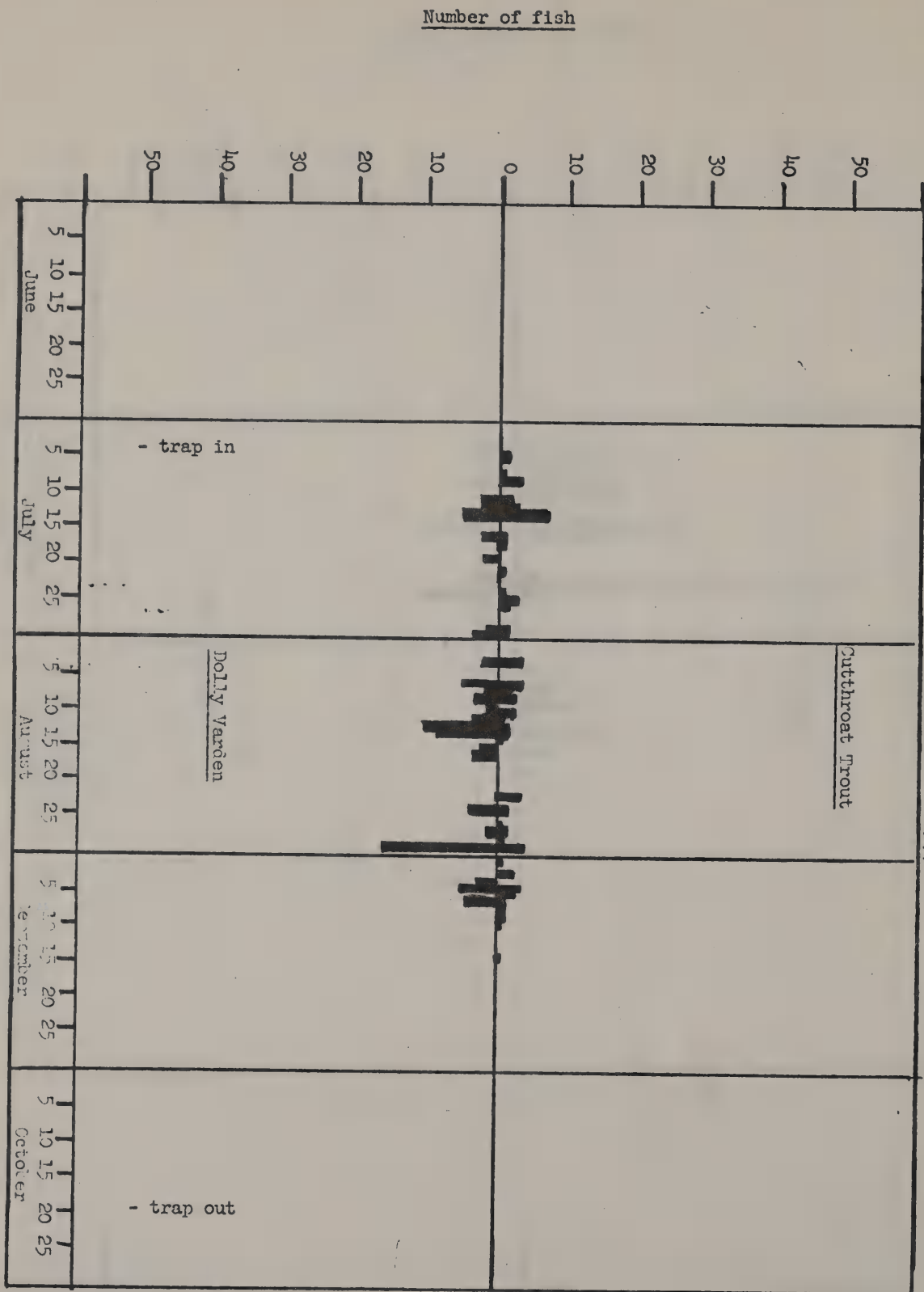
on Coal Creek - 1977



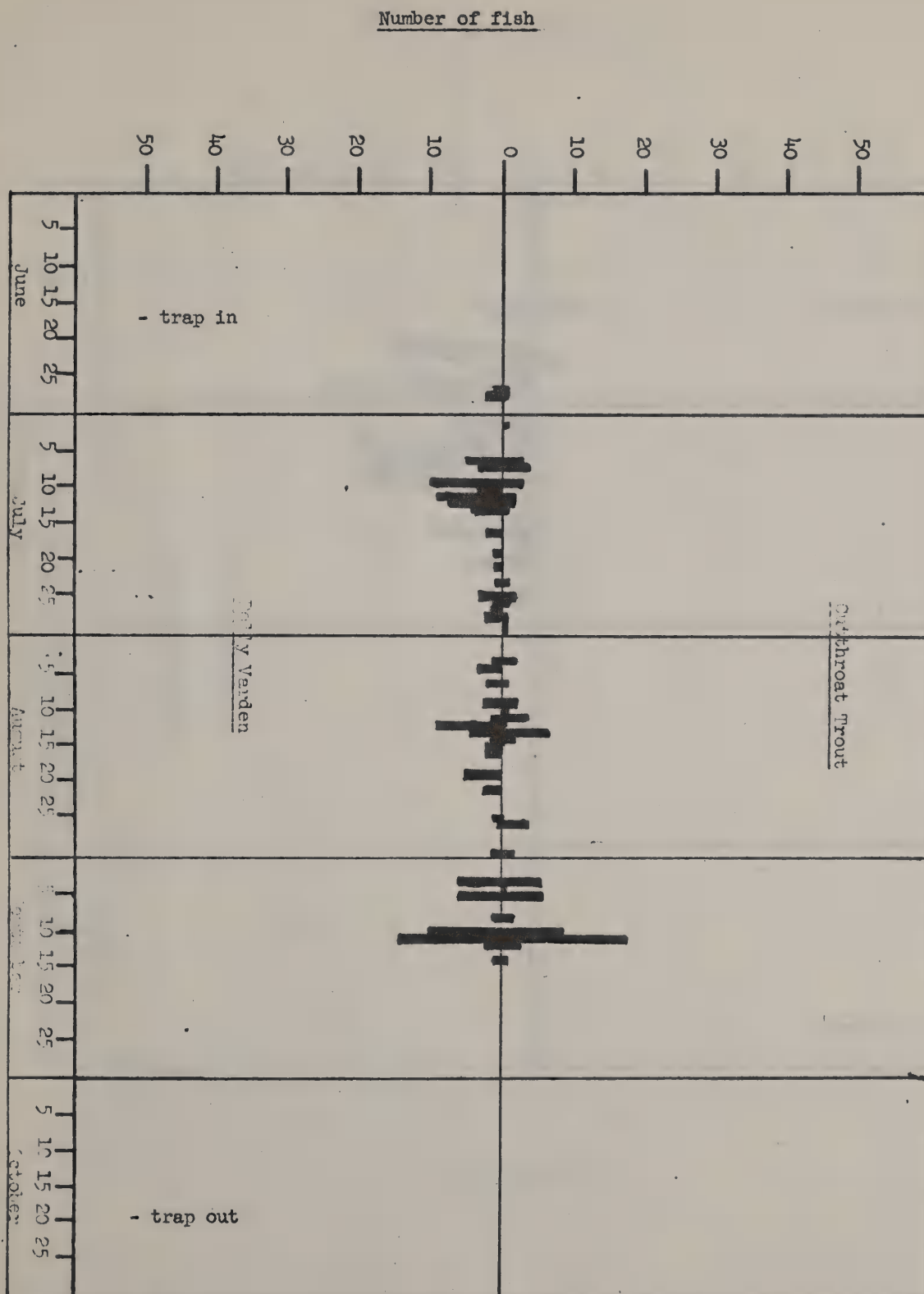
Downstream Trap Catch of Juvenile Dolly Varden & Cutthroat Trout  
on Elk Creek - 1977



Downstream Trap Catch of Juvenile Dolly Varden & Cutthroat Trout  
on Whale Creek - 1977

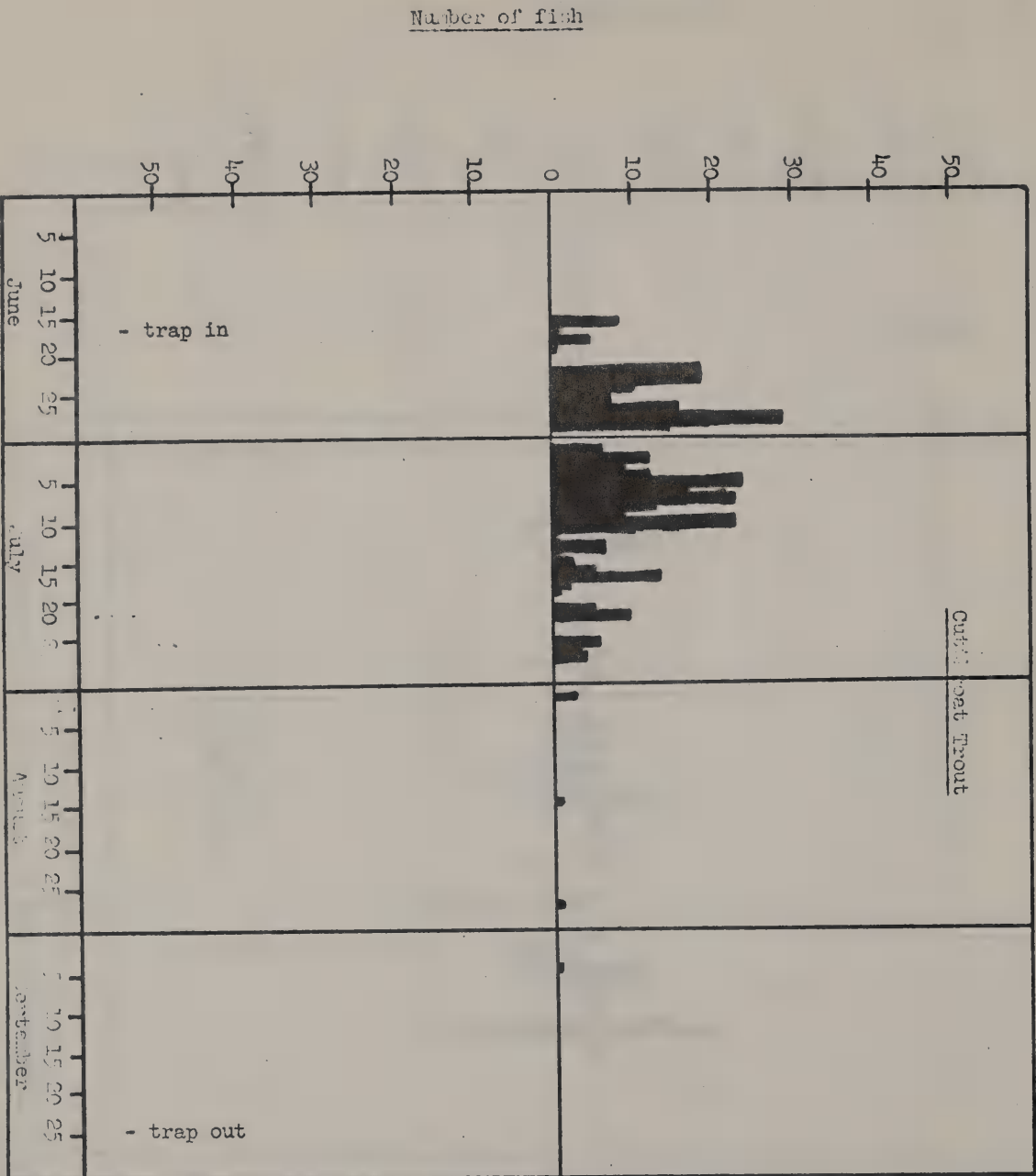


Downstream Trap Catch of Juvenile Dolly Varden & Cutthroat Trout  
on Trail Creek - 1977

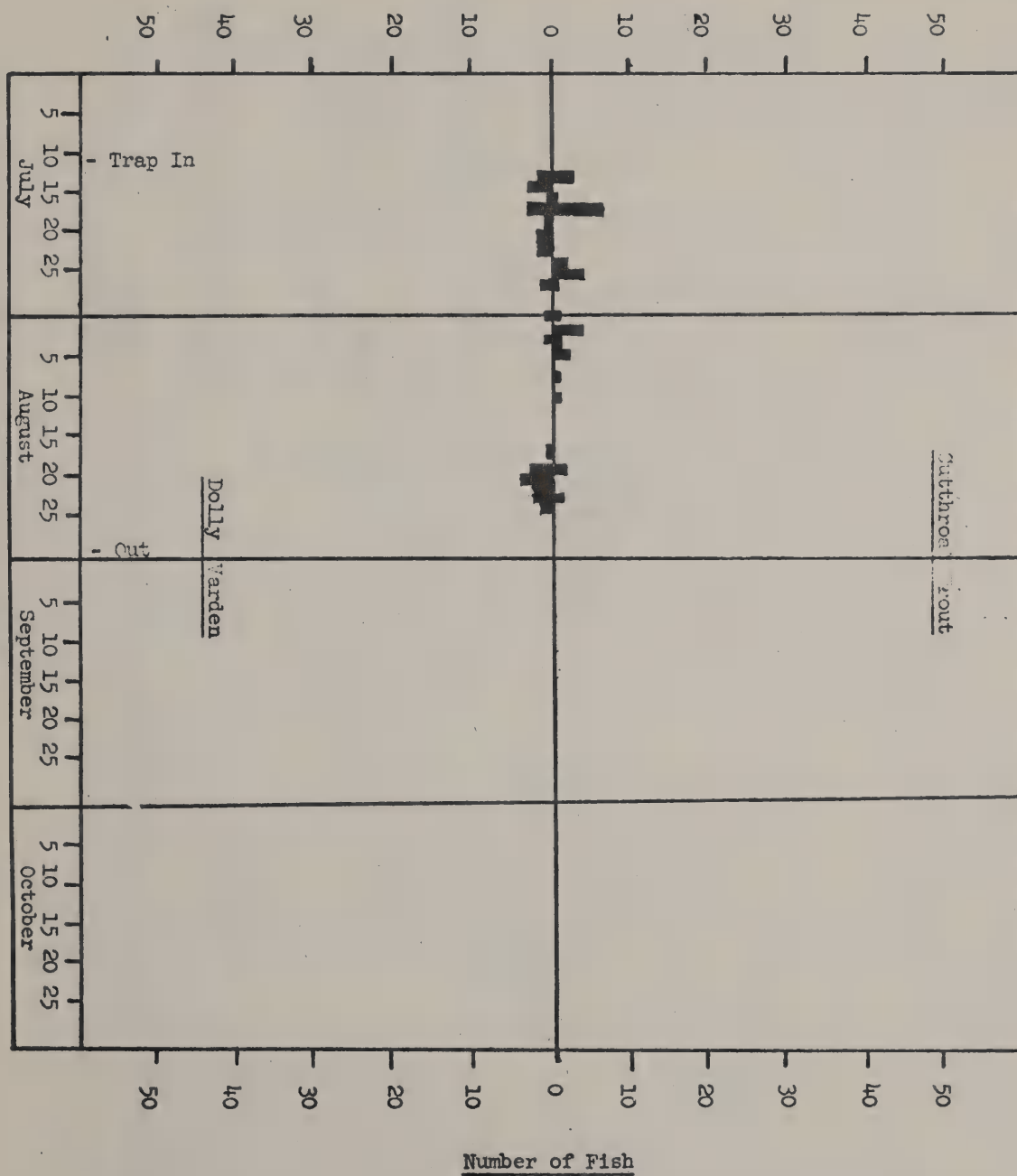


Downstream Trap Catch of Juvenile Cutthroat Trout

on Mokala Creek - 1977



Northwest Trap Catch of Juvenile Dolly Varden & Cutthroat Trout  
on Fairweather Creek - 1978



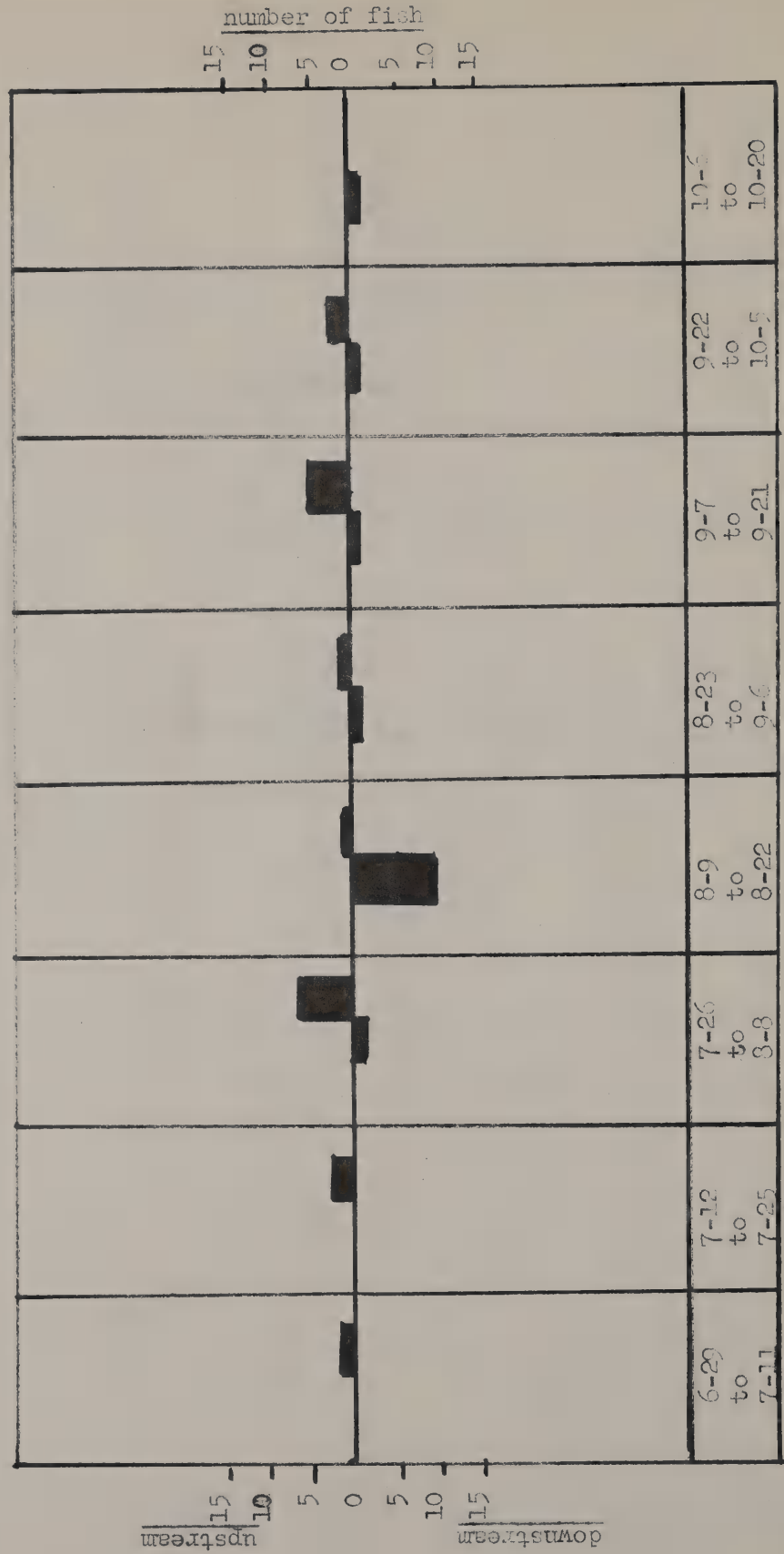


APPENDIX VI:

Summary of Weekly Trap Catch for  
Upstream and Downstream Movement of  
Adult Dolly Varden

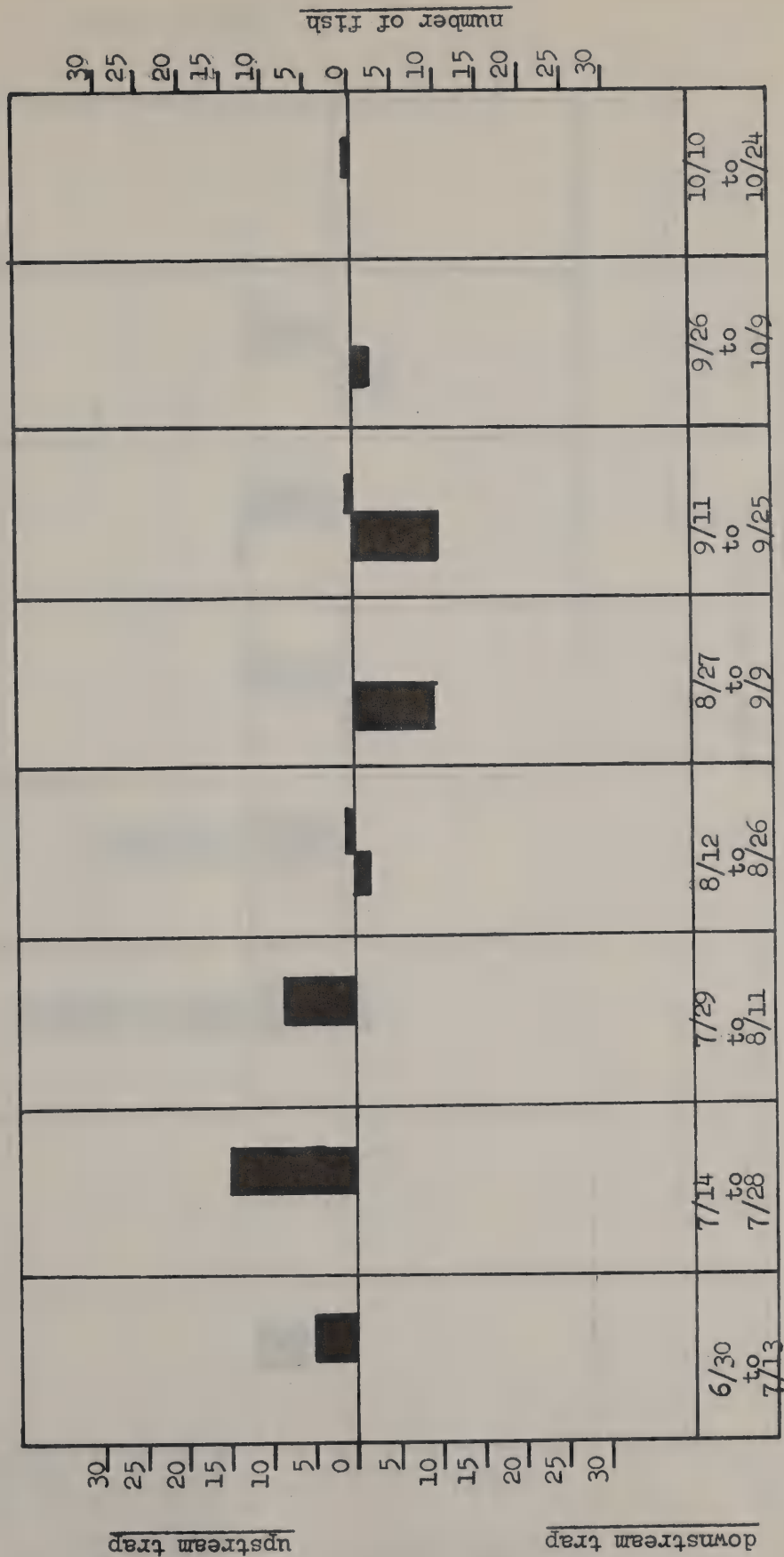
# Big Creek Trap Catch for Dolly Varden - 1977

(adult fish only)



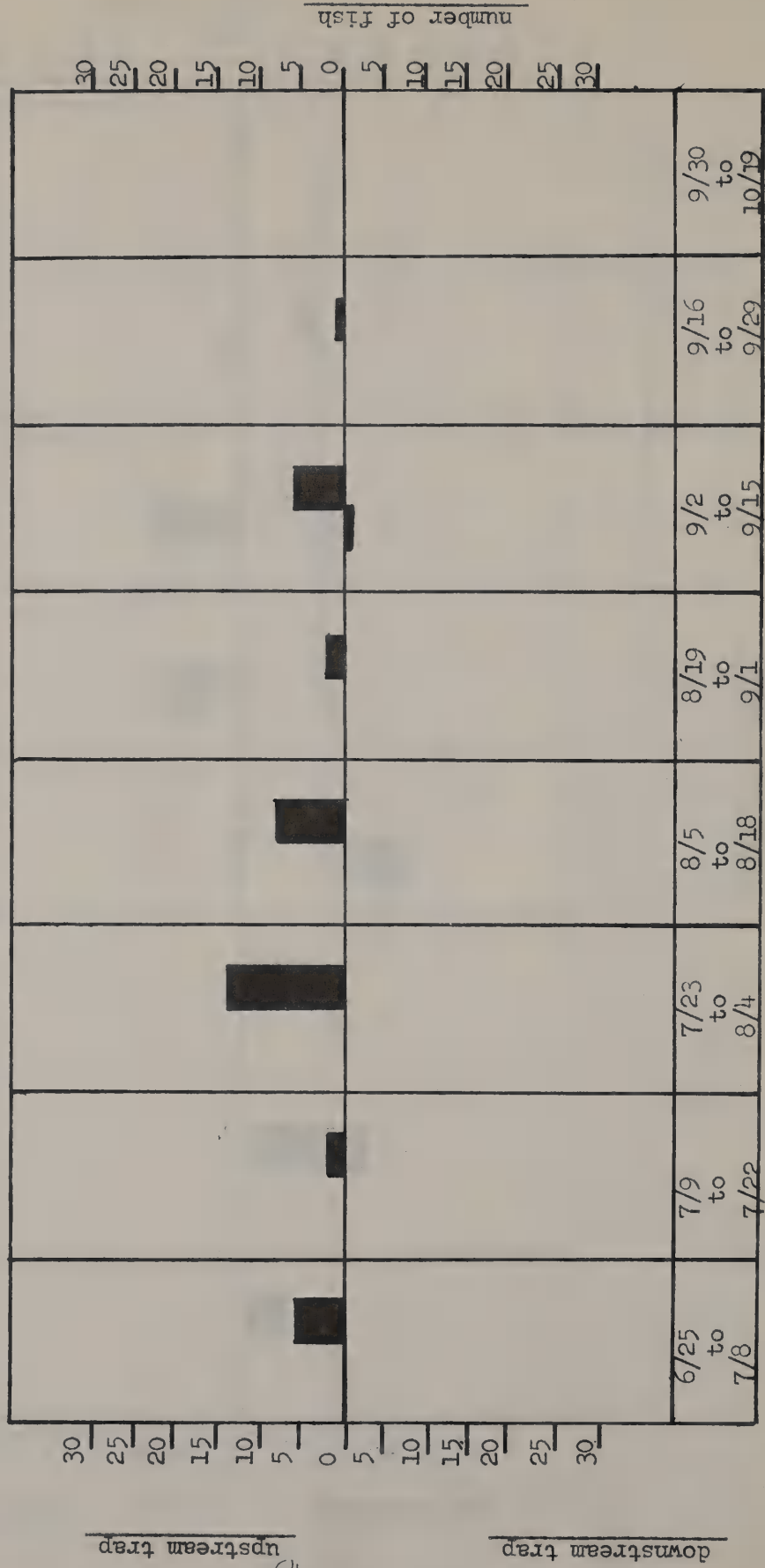
# Coal Creek Trap catch for Dolly Varden - 1977

(adult fish only)



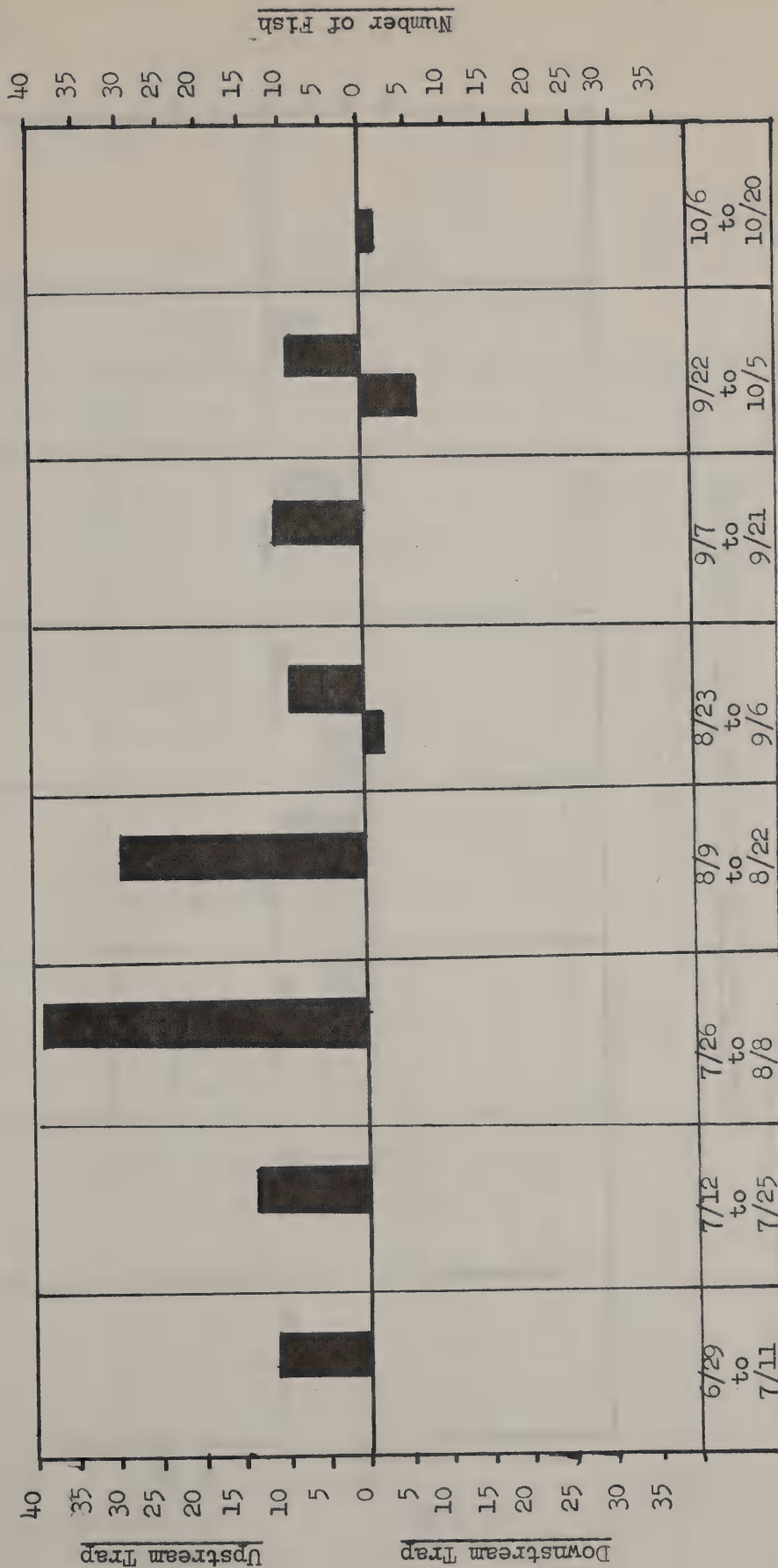
# Red Meadow Creek Trap catch for Dolly Varden-- 1977

(adult fish only)



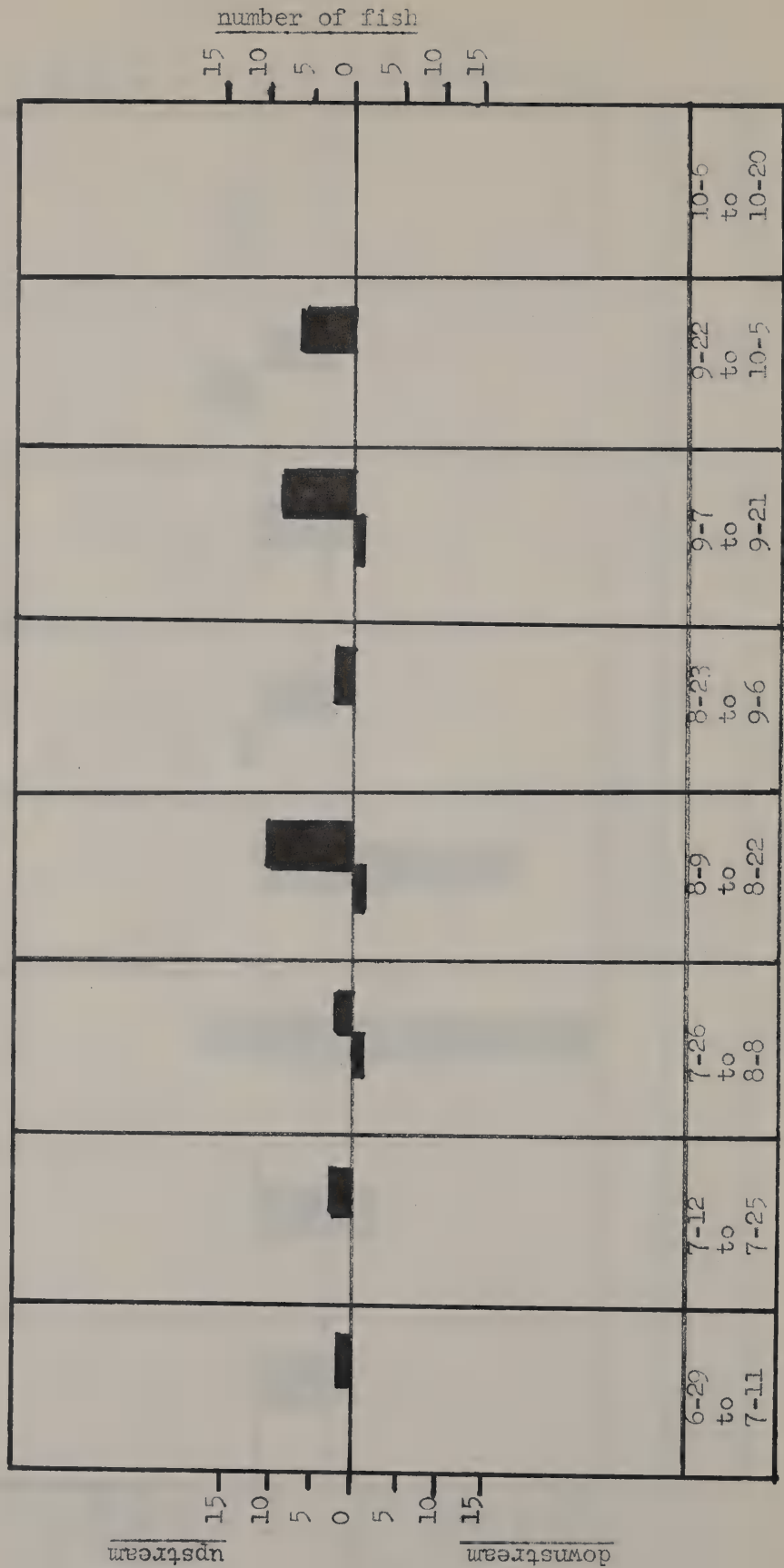
# Whale Creek Trap Catch for Dolly Varden-1977

(adult fish only)



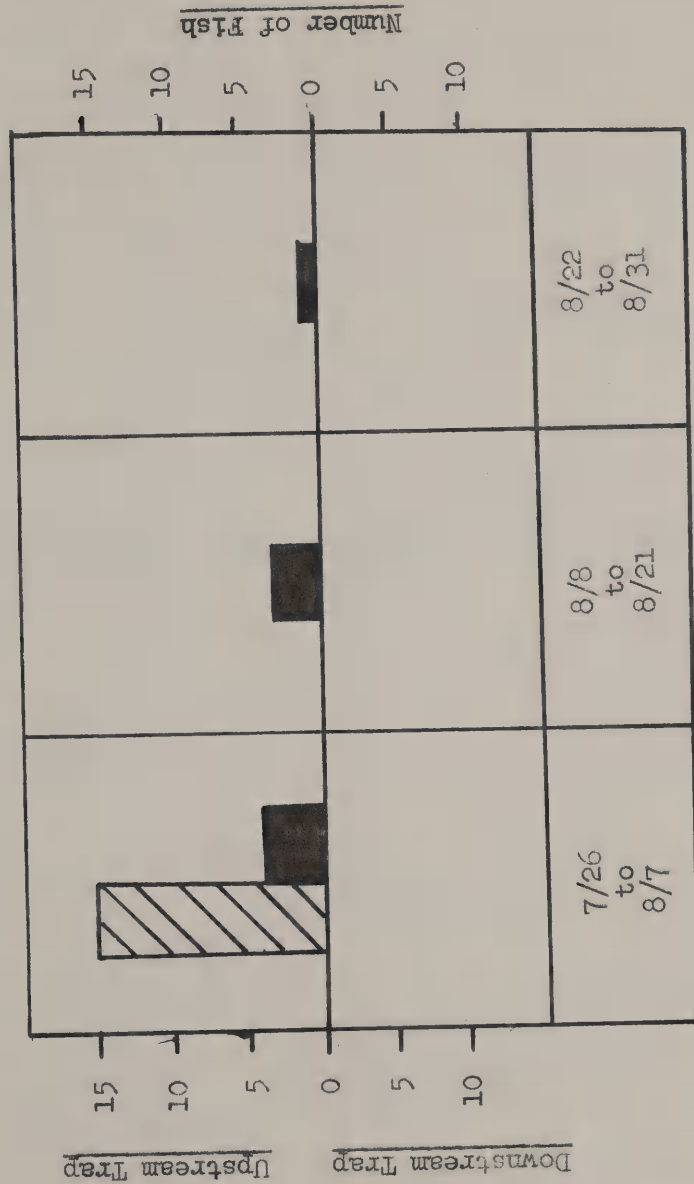
# Trail Creek Trap Catch for Dolly Varden - 1977



(adult fish only)



# Trap Catch for Dolly Varden on Kishenehn & Starvation Creeks - 1978

(adult fish only)



 - Starvation Creek  
 - Kishenehn Creek

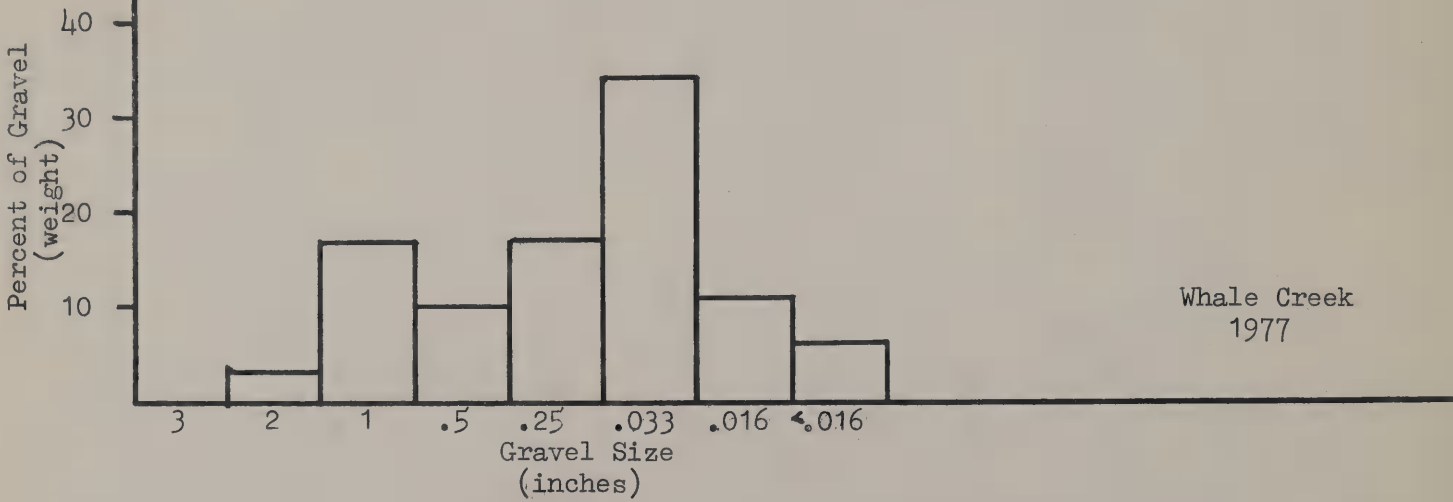
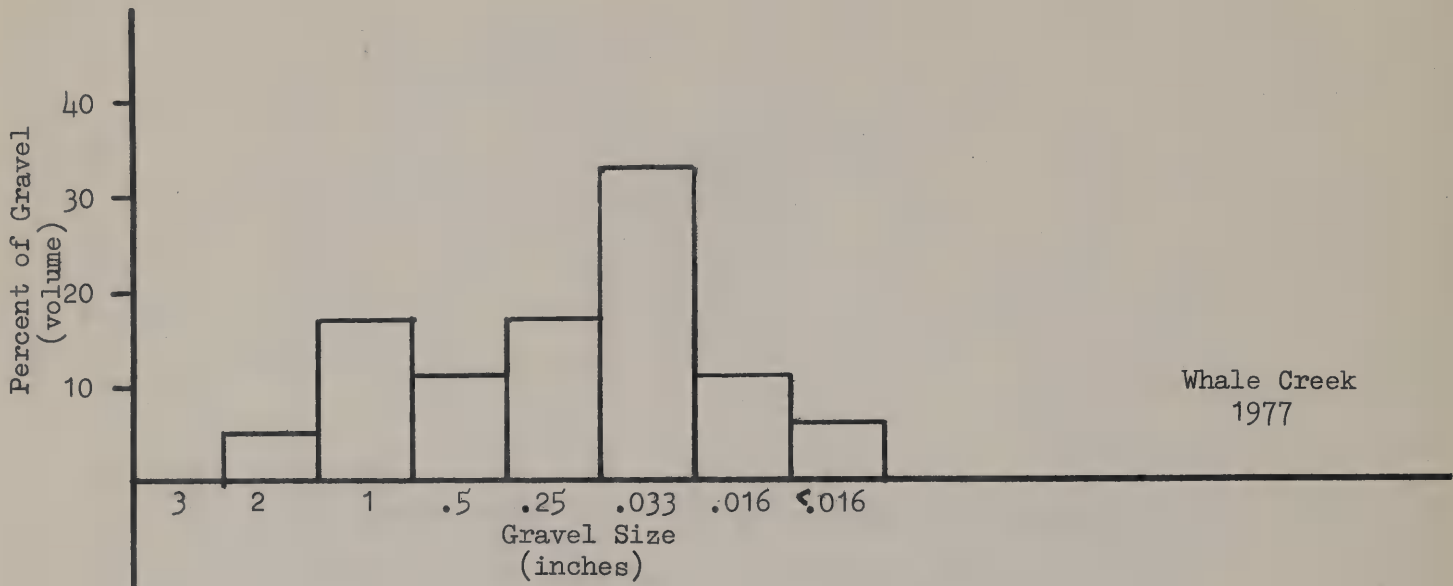


APPENDIX VII:

Results of Volumetric and Weight Measurements  
of Gravel Samples taken from Dolly Varden Redds

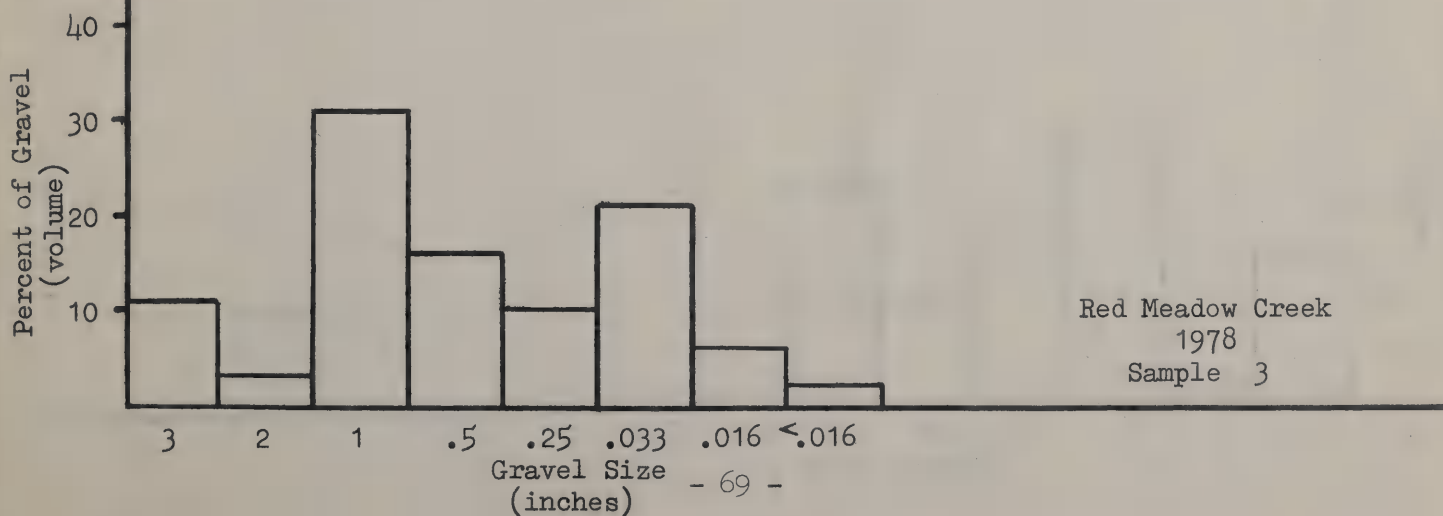
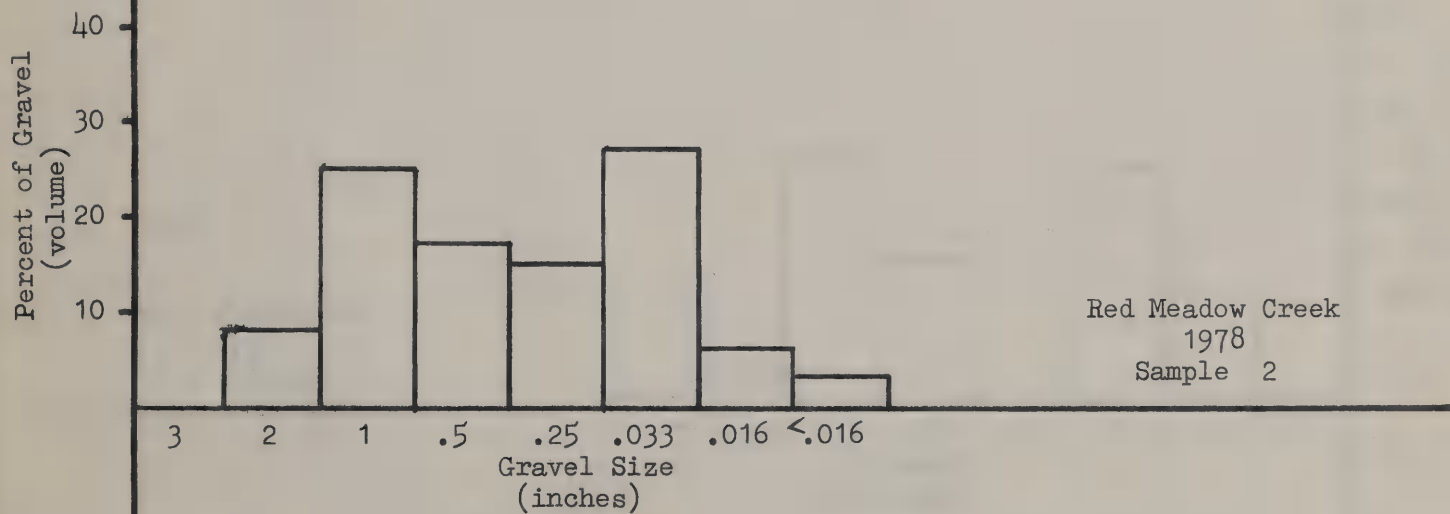
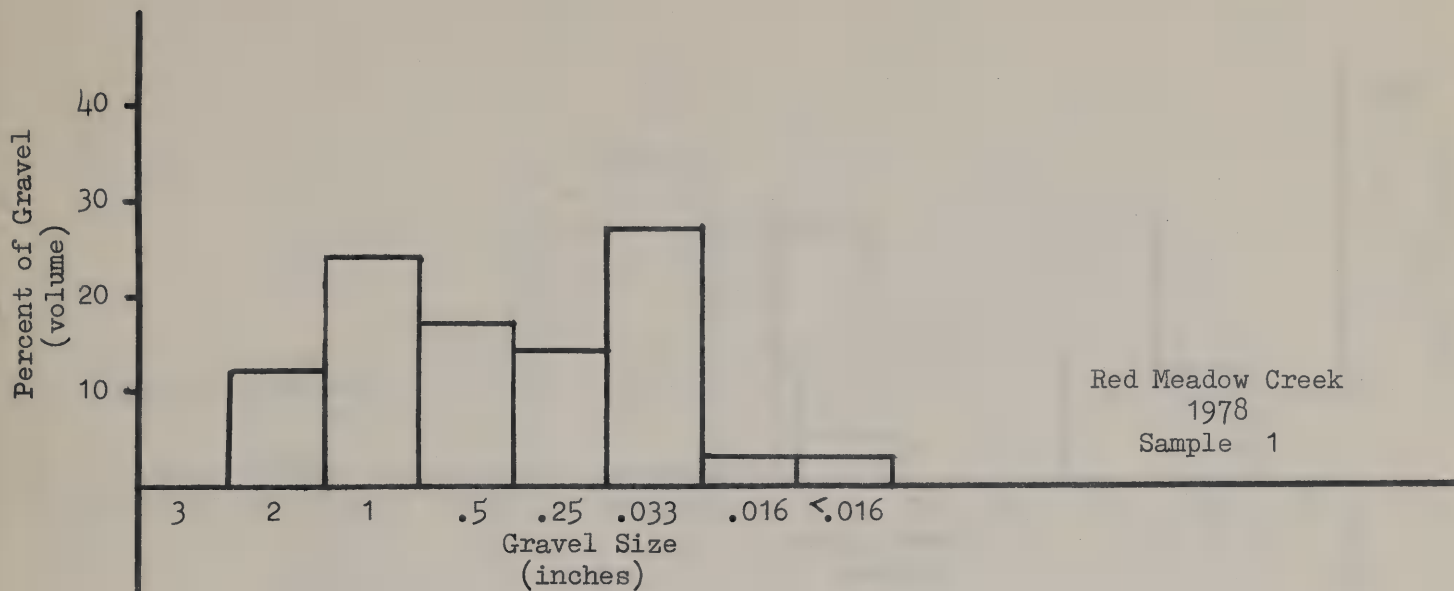
DOLLY VARDEN REDD

GRAVEL SAMPLES



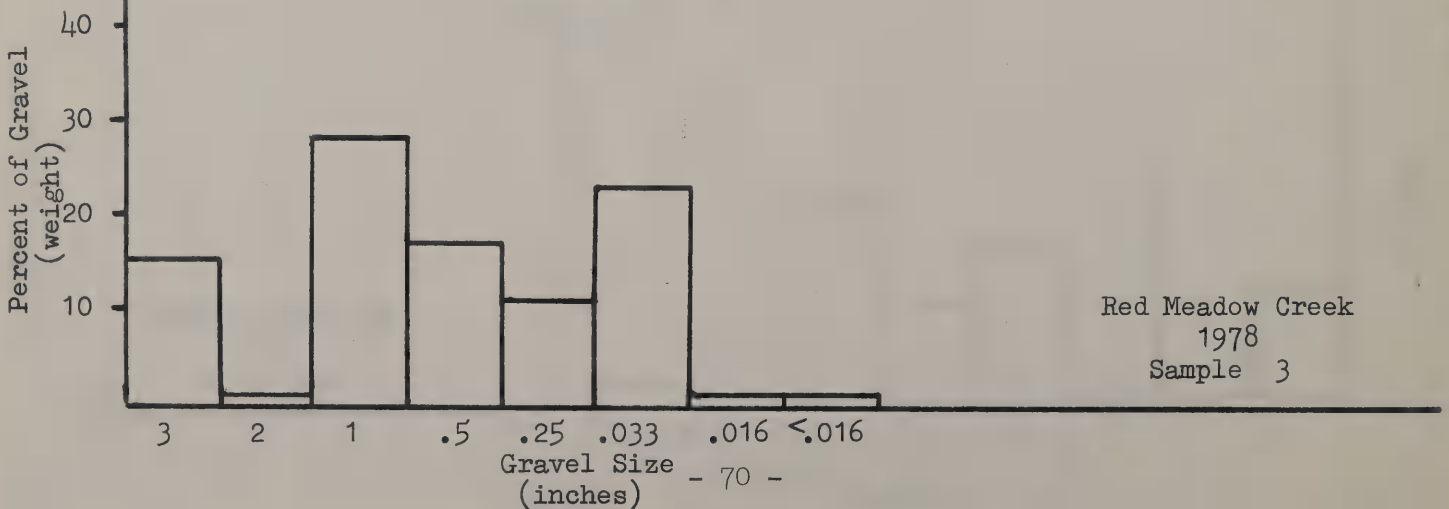
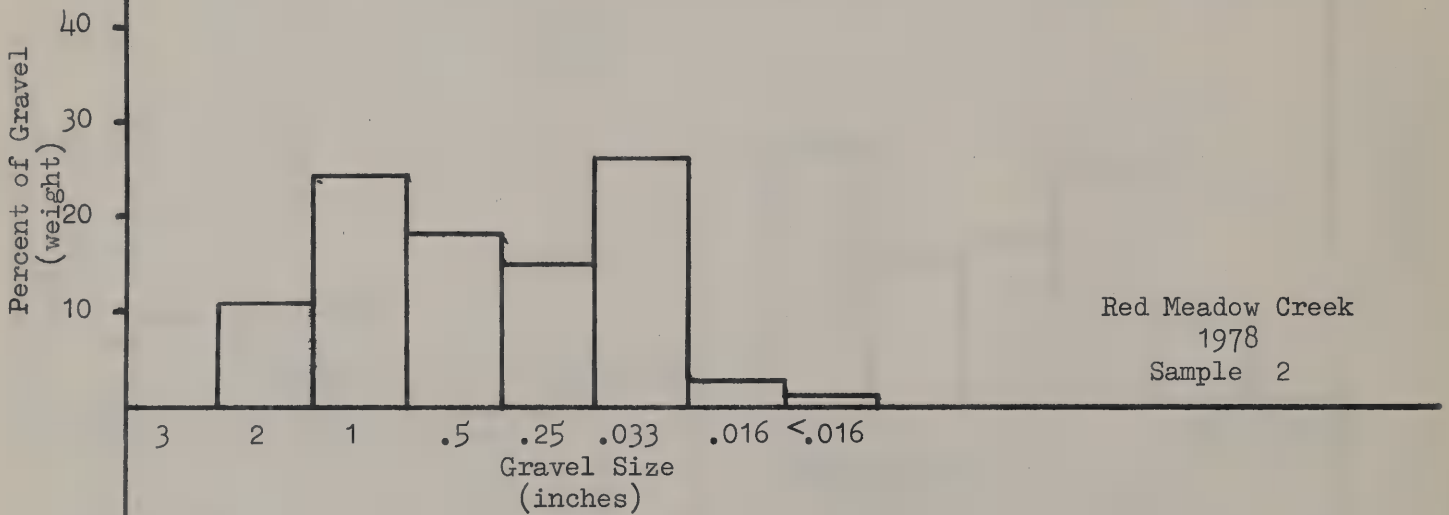
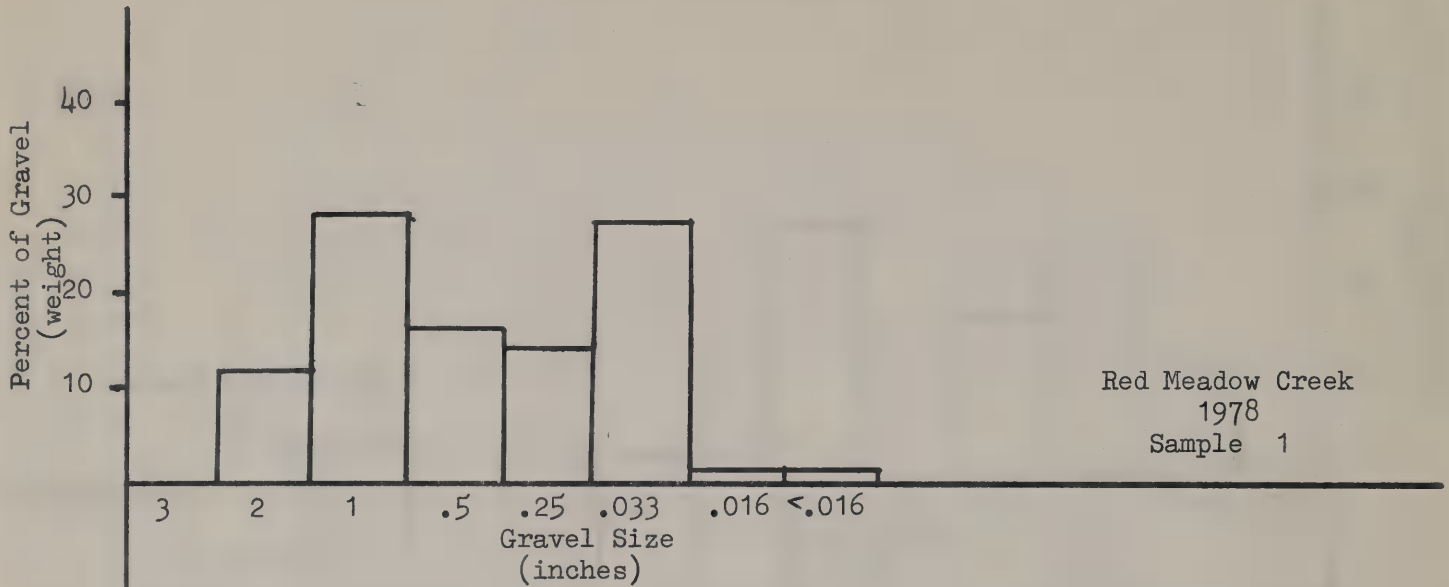
DOLLY VARDEN REDD

GRAVEL SAMPLES



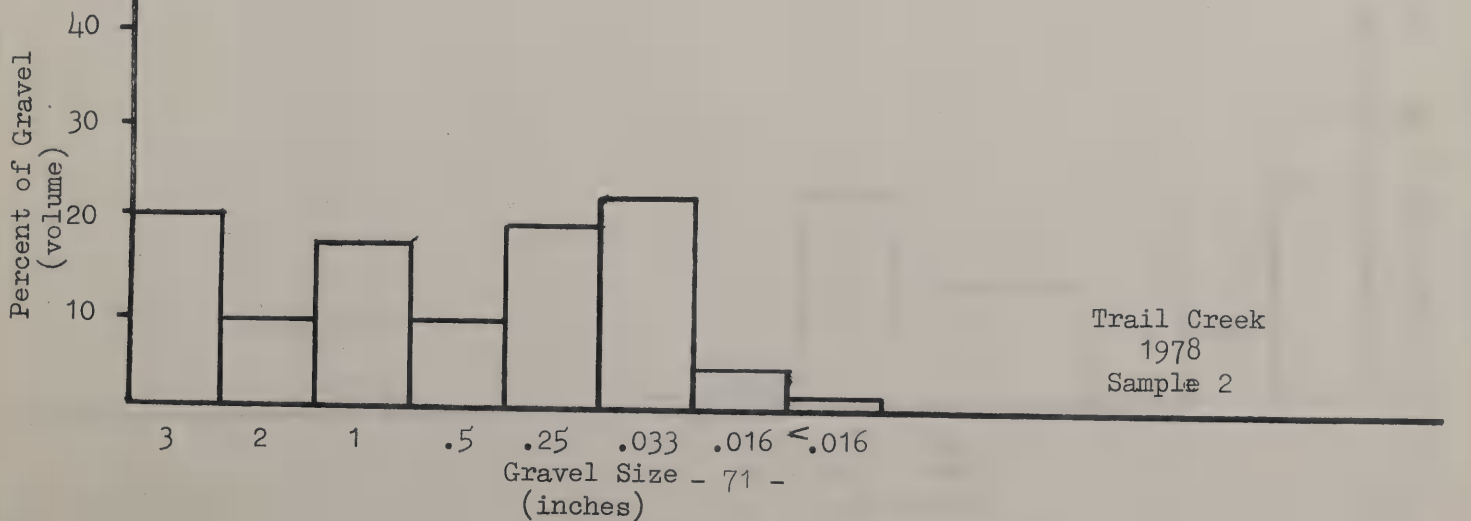
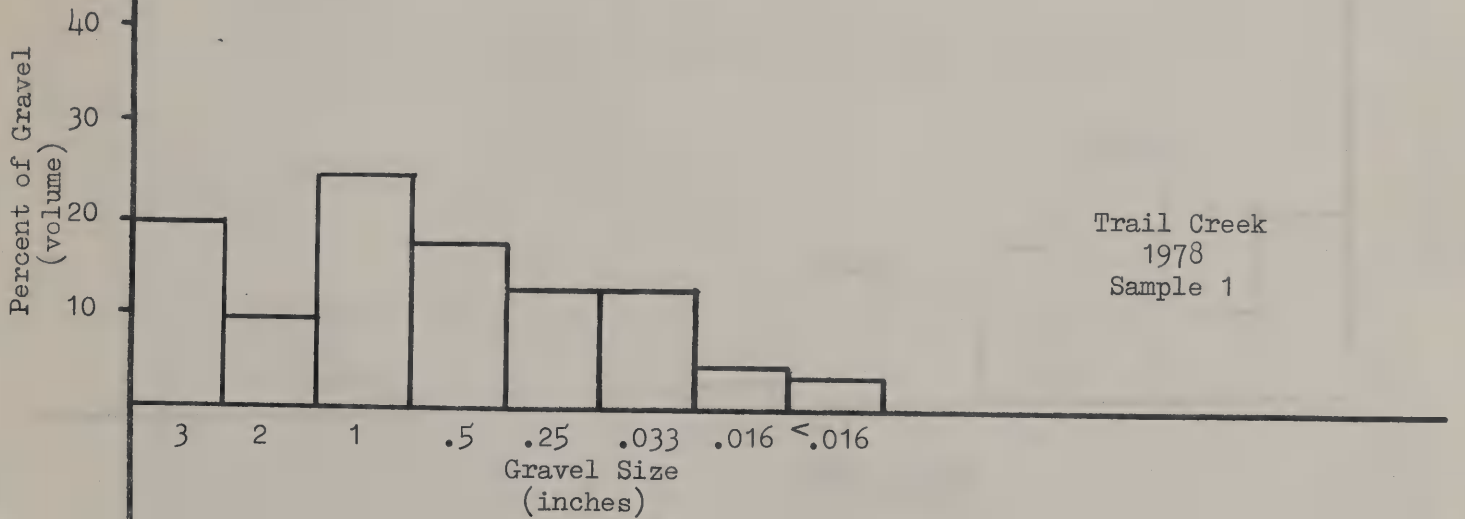
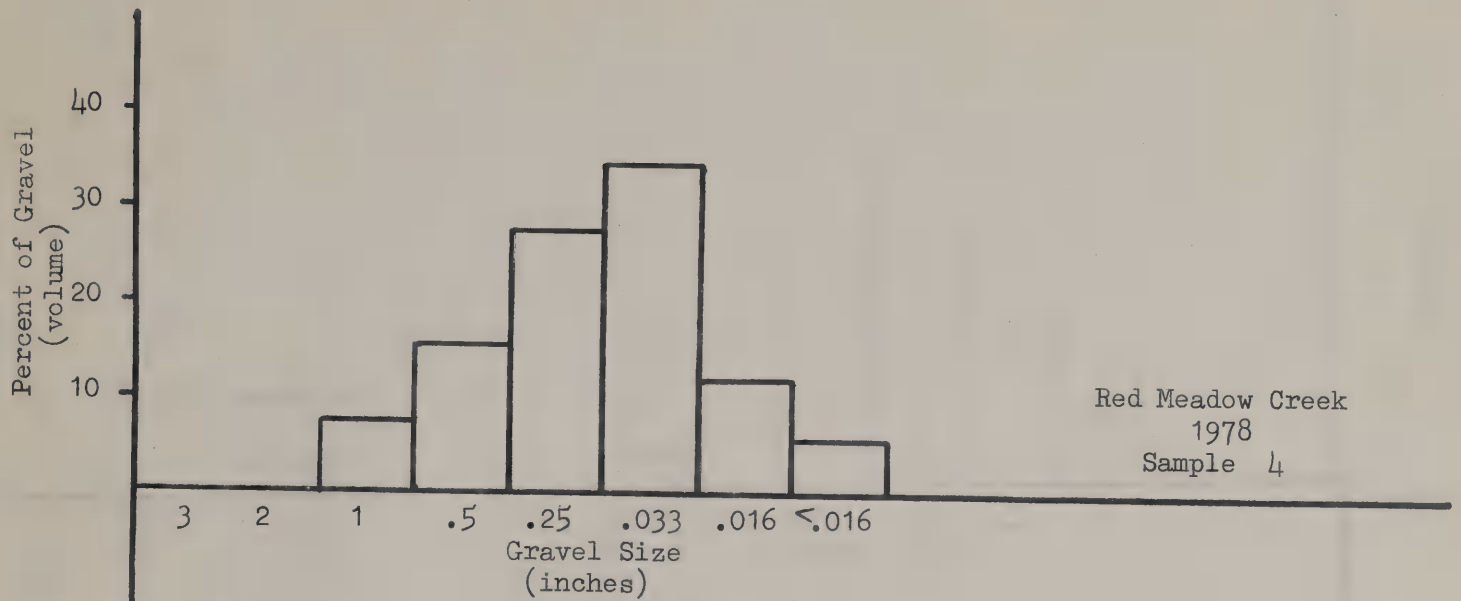
DOLLY VARDEN REDD

GRAVEL SAMPLES



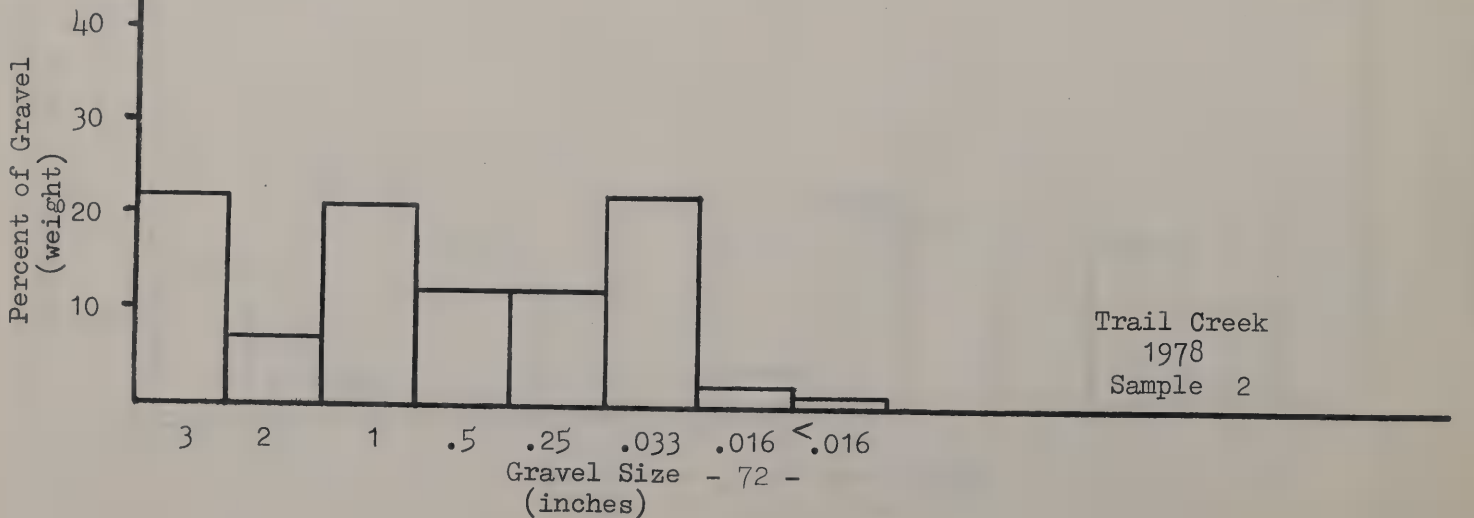
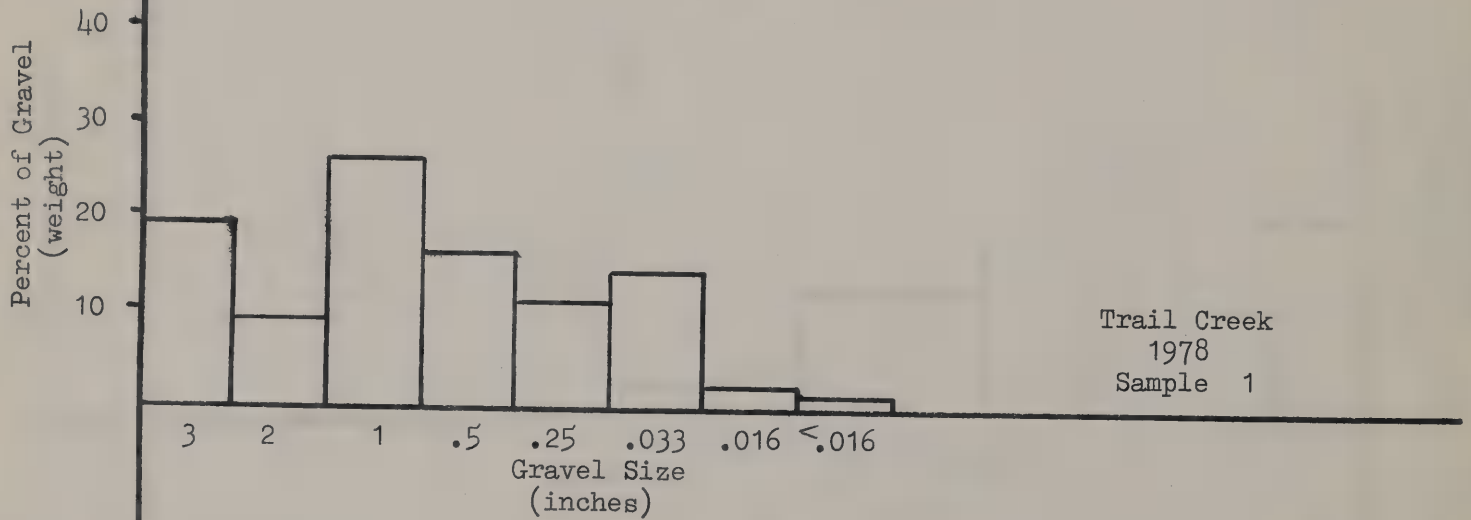
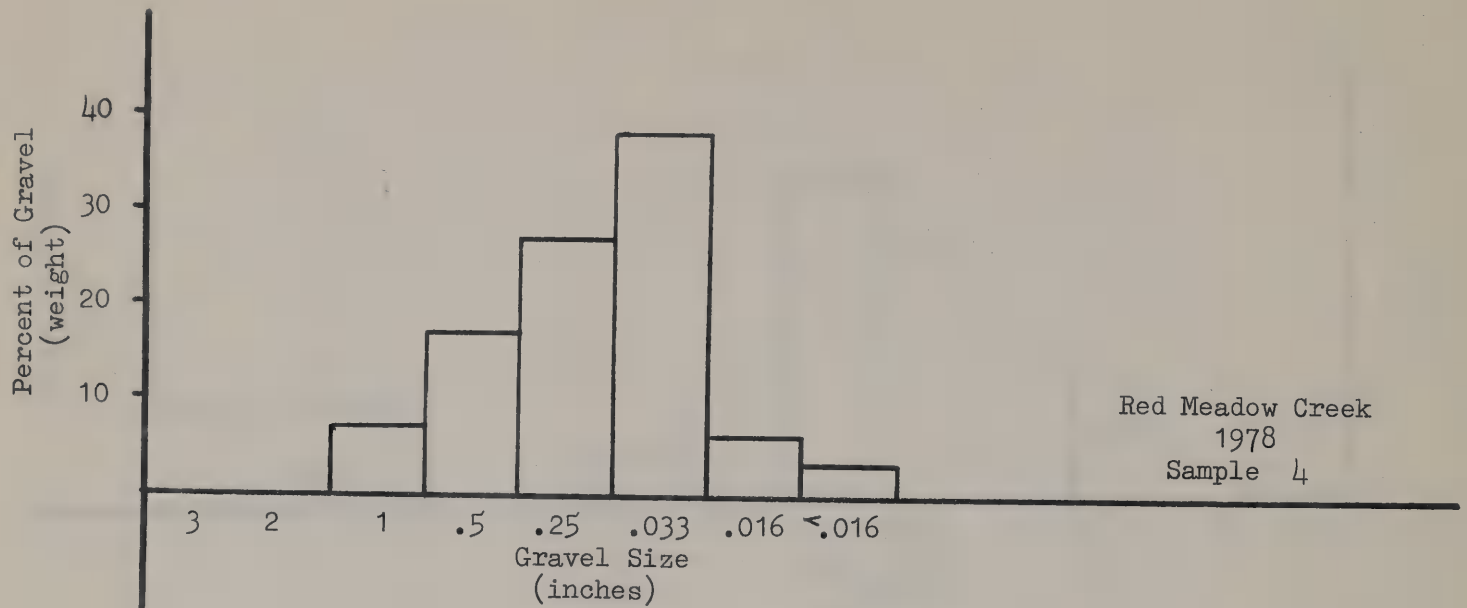
DOLLY VARDEN REDD

GRAVEL SAMPLES



DOLLY VARDEN REDD

GRAVEL SAMPLES



APPENDIX VIII:

Egg Counts from Prespawning Dolly Varden Mortalities

## 1977 DOLLY VARDEN EGG COUNTS

Overall Measures		Weight of		Number of	
Length (inches)	Weight (pounds)	500 Eggs (pounds)	Excess Eggs (pounds)	Eggs Per Fish	Eggs Per Pound
17.8	2.0	.04	.17	2,125	1,040
21.2	3.0	.04	.23	2,875	955
22.3	3.9	.06	.44	3,665	940
23.0	4.0	--	--	3,330	830
23.2	4.8	.08	.70	4,375	910
23.5	5.7	.07	.87	5,365	940
23.5	6.0	--	--	3,330	555
23.7	5.0	.06	.48	4,000	800
23.9	5.0	--	--	3,625	725
24.0	--	.07	.61	4,355	--
24.2	6.0	.07	.73	5,210	870
24.5	4.9	.05	.50	4,255	870
25.1	5.5	.09	.86	4,780	870
25.2	6.0	.06	.59	4,915	820
25.3	6.2	.06	.69	5,750	925
25.7	6.5	.09	.67	3,725	575
26.2	7.0	.06	.74	6,445	920
26.3	7.3	.08	.88	6,125	840
26.3	7.0	.08	.76	4,750	680
26.4	7.0	.06	.63	5,250	750
27.9	9.0	--	--	11,500	1,275
28.0	7.5	.08	1.12	7,000	935
28.1	8.0	.08	.96	12,000	1,500
28.2	7.5	.06	.63	5,800	785
28.3	--	.07	1.46	10,925	--
28.3	8.5	.07	1.00	7,140	840
28.5	10.5	.10	1.09	6,330	600
29.0	8.0	.08	1.36	8,500	1,060
29.4	10.5	.06	1.17	9,750	930
29.7	9.0	.06	.98	8,165	910
29.7	9.5	.08	1.27	9,000	950
31.7	12.0	.08	1.54	9,625	800
Means: Length	Weight			Eggs	Eggs/lb.
25.4	6.15			5,482	851



